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NOTES ON THE VAQUEROS AND TEMBLOR
FORMATIONS OF THE CALIFORNIA MIOCENE
WITH DESCRIPTIONS OF NEW SPECIES

BY

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NOTES ON THE VAQUEROS AND TEBLOR FORMATIONS OF THE CALIFORNIA MIOCENE WITH DESCRIPTIONS OF NEW SPECIES

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INTRODUCTION

In the pursuance of field studies by the writer on the paleontologic and stratigraphic relations of the Vaqueros and Temblor formations of the lower and middle Miocene, respectively, to adjoining formations in California, extensive collections of molluscan fossils from both were carefully observed and examined.

The chief result of this study, here presented, is that, even though the Temblor formation has had its fauna described in some detail by Frank M. Anderson, Ralph Arnold, and others, several new species have been discovered. The fauna of the Vaqueros, in contrast to that of the Temblor, has been less adequately and more scatteringly described by Ralph Arnold and others. Both Conrad and Gabb had described, as well, fossils from both of the formations considered, but without reference to formation and, only in general, to horizon.

No attempt is here made to monograph the faunas of either of these formations, but, rather, to describe the new species which have been secured in the course of such field work as has been thus far completed. All of the material studied has been collected from widely scattered localities in the state south of the San Francisco Bay region, as far south as San Diego County, and represents, principally, collections made during the summer of 1927. The collections at Leland Stanford Junior University bearing upon the present study have been considered. In addition, a collection of Temblor material from the Santa Monica Mountains of southern California at the University of California at Los Angeles has been made accessible for study. Types and such other forms as were pertinent to the study and which were available have been compared by the writer.

The principal collections studied were made by the writer. Some of the Temblor material was collected by Mr. Merrill E. Lake, geologist for the Richfield Oil Company at Fellows, California. A few specimens were collected by the Stanford summer field geology class from the Vaqueros of the Santa Paula and Ventura quadrangles of Ventura County and from the San Juan Bautista quadrangle of

San Benito County, both of this state. A few additional fossils were collected by other geologists.

The intention of the writer in the present paper is to record the additional information which has been secured concerning the faunas of the two formations here considered, and to present a list of the commonly associated forms with the new species at their respective localities.

The writer wishes to express appreciation for the helpful suggestions and constructive criticisms received from Dr. James Perrin Smith and Dr. Hubert G. Schenck, both of the Department of Geology of Leland Stanford Junior University, in the preparation of this manuscript; for the courtesy extended and the aid given by Mr. Merrill E. Lake to the writer while in the vicinity of the southern San Joaquin Valley, and for the assistance given in the comparison of the fossil with the living forms by Mrs. I. S. Oldroyd, Curator of the Conchological Museum of Leland Stanford Junior University, deep gratitude is felt. Indebtedness to Mr. William Kleinpell and Mr. B. F. Hake for permission to name and figure a new and interesting form collected by them is also expressed. To my colleagues, Mr. U. S. Grant and Mr. H. R. Gale, for their patient indulgence at all times much credit is due.

HISTORICAL REVIEW

THE VAQUEROS FORMATION

The Vaqueros formation derived its formational name from the occurrence of a series of sandstones of marine origin which are well developed and exposed on Vaqueros Creek, about five miles west of Greenfield, a small town in the Salinas Valley, California. Homer Hamlin¹ observed that this series of beds immediately underlies the Monterey shale and overlies the "basement complex," which, in the canyon of the type section, is a granite. Because of the unnamed occurrence of beds in the stratigraphic position in which he discovered these, he proposed that the name Vaquero be used for the formation.

Fairbanks, by communication with Hamlin, learned of the latter's

¹ HAMLIN, HOMER, Water Resources of the Salinas Valley, U.S. Geological Survey Water Supply Paper, No. 89, p. 14, 1904.

intention to name these beds, and upon finding in his work on the geology of the San Luis Obispo region,² about eighty miles to the south of the Vaqueros Canyon section, a series of beds in the same apparent stratigraphic position, and of similar lithologic character, proposed, also, that the name be adopted. Consequently, Fairbanks has been accredited with having named the formation, since it has been commonly accepted that he antedated Hamlin in print on the subject in question. On the other hand, Miss Grace Wilmarth,³ secretary to the Committee on Nomenclature of the United States Geological Survey, informs the writer that both Hamlin's and Fairbanks' papers were completed and delivered simultaneously by the press on June 20, 1904.⁴ Apparently the honor of having named the Vaqueros has been improperly assigned and must, as a result, be attributed to Hamlin.

It may be noted, however, that the name chosen by both Hamlin and Fairbanks was Vaquero, not Vaqueros. The Committee on Nomenclature of the United States Geological Survey, the year following the printing of the papers by Hamlin and Fairbanks, upon finding that the canyon of the type section was improperly printed as "Vaquero" on current maps (a fact which introduced the error in name), formally decided that Vaqueros should be used. It has been consistently used by the national survey since that time.

Neither Hamlin nor Fairbanks discussed the fauna of the Vaqueros. But just prior to the formal naming of the formation, J. C. Merriam⁵ published a short foresighted paper treating of the fauna of the lower Miocene formations, so far as then known, with their relationships, though at that time they remained undifferentiated as stratigraphic units. He displayed foresight in recognizing that time, not ecologic differences, characterize the two faunas.

² FAIRBANKS, H. W., San Luis Obispo Folio, U.S. Geological Survey, Geological Atlas, No. 101, p. 3, 1904.

³ By written communication, May of 1927.

⁴ MERRIAM, JOHN C., Transactions of the American Philosophical Society, N.S., Vol. 22, Part 3, p. 15, footnote 4, 1915, indicates what are probably the dates on which the actual printing of the publications was completed, not official dates of publications recognized by the U.S. Geological Survey, which accepts June 20, 1904, for both Hamlin's and Fairbanks' papers.

⁵ MERRIAM, JOHN C., Notes on the Fauna of the Lower Miocene in California, University of California Publications, Bulletin of the Department of Geology, Vol. 3, No. 16, p. 377, 1904.

Later, Ralph Arnold⁶ described a few species from the Vaqueros of the Santa Clara Valley of the south. This paper was closely followed by one in which Arnold⁷ described a fauna from the Vaqueros formation of the Santa Cruz Mountains on the San Francisco peninsula, about ninety miles north of the type section, after both Hamlin and Fairbanks had given faunal lists to characterize the Vaqueros strata in their papers. Conrad⁸ and Gabb⁹ in various publications had already described, from among collections coming under their observations, many Miocene forms, some of which by the work of Arnold and others proved to be species occurring in the Vaqueros.

Another part of the state where sedimentary beds of Vaqueros age outcrop is in the vicinity of Santa Maria in Santa Barbara County. Ralph Arnold and Robert VanV. Anderson¹⁰ mapped these in their report on that region. Shortly later, Arnold¹¹ described the new species from the Vaqueros of the Santa Maria region, as well as from the Vaqueros of the Santa Lucia Mountain region, which is about twenty-five miles south of the type section of the formation. Personal investigation by the writer in the general vicinity of the type section of the Vaqueros demonstrates that the faunas described by Arnold may be correlated with the fauna of the Vaqueros at the type section.

Between the gap of the published reports cited and compara-

⁶ ARNOLD, RALPH, New and Characteristic Species of Fossil Mollusks from the Oil-Bearing Tertiary Formations of Southern California, Proceedings of the U.S. National Museum, Vol. 32, p. 525, 1907.

⁷ ARNOLD, RALPH, Descriptions of New Cretaceous and Tertiary Fossils from the Santa Cruz Mountains, California, Proceedings of the U.S. National Museum, Vol. 34, p. 349, 1904.

⁸ CONRAD, T. A., Pacific Railroad Reports, Vols. 5, 6, 7, 1856, 1857, 1857, respectively.

⁹ GABB, W. M., Geological Survey of California, Paleontology, Vol. 2, 1869.

¹⁰ ARNOLD, RALPH, and ANDERSON, ROBERT VANV., Geology and Oil Resources of the Santa Maria Oil District, Santa Barbara County, California, U.S. Geological Survey Bulletin No. 322, 1907.

¹¹ ARNOLD, RALPH, New and Characteristic Species of Fossil Mollusks from the Oil-Bearing Tertiary Formations of Santa Barbara County, California, Smithsonian Miscellaneous Collection, Vol. 50, Publication No. 1780, p. 419, 1907.

tively recent work are two papers by John C. Merriam¹² and J. P. Smith.¹³ The former discussed the correlation of certain Miocene deposits of the San Joaquin Valley upon the basis of vertebrate faunas. Professor Smith summarized the extant knowledge of the ecologic and faunal characteristics of the Vaqueros formation, and pointed out that tropical or subtropical temperatures of the sea prevailed. Considerably later Kew¹⁴ mapped extensive outcrops of the formation in the Santa Monica Mountains and on South Mountain of Los Angeles and Ventura Counties, respectively, which he found generally occurring conformably immediately above the Sespe¹⁵ formation. Woodford,¹⁶ working in southern Orange County along the coast, mapped a series of sandstones which he correlated with the Vaqueros. Kerr and Schenck¹⁷ mapped and discussed the occurrence of the Vaqueros in the central part of California in the San Juan Bautista quadrangle. English,¹⁸ shortly after, in the Santa Ana Mountains of Orange County, cited the Vaqueros as well developed.

¹² MERRIAM, JOHN C., Tertiary Vertebrate Faunas of the North Coalinga Region of California, Transactions of the American Philosophical Society, N.S., Vol. 22, Part 3, 1915.

¹³ SMITH, JAMES PERRIN, Climatic Relations of the Tertiary and Quaternary Faunas of the California Region, Proceedings of the California Academy of Sciences, 4th ser., Vol. 9, No. 4, p. 160, 1919.

¹⁴ KEW, W. S. W., Geology and Oil Resources of a Part of Los Angeles and Ventura Counties, U.S. Geological Survey Bulletin No. 753, 1924.

¹⁵ The Sespe formation was named by W. L. Watts, California State Mining Bureau Publications, Bulletin No. 11, p. 25, 1897, with the type locality in the Sespe district, Ventura County, California. The Sespe formation is a unique "red bed" series of over three thousand feet in thickness, made up of sandstones and shales of apparently fresh-water deposition. The formation, which occurs only along the coastal section of the southern part of California, is probably of upper Oligocene or lower Miocene age.

¹⁶ WOODFORD, A. O., The San Onofre Breccia, Its Nature and Origin, University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 15, No. 7, p. 178, 1925.

¹⁷ KERR, P. F., and SCHENCK, H. G., Active Thrust-Faults in San Benito County, California, Bulletin of the Geological Society of America, Vol. 36, p. 465, 1925.

¹⁸ ENGLISH, W. A., Geology and Oil Resources of Puente Hills Region, Southern California, U.S. Geological Survey Bulletin No. 768, 1926.

In a late paper Hertlein and Jordan¹⁹ record and describe a few fossil species possibly of Vaqueros age from the Miocene of Lower California. The stratigraphic relations of the Vaqueros formation of the Ventura and the Santa Paula quadrangles of Ventura County will appear in a forthcoming paper by Kerr and Schenck.

THE TEMBLOR FORMATION

The Temblor formation received its formational name from the occurrence of a series of sandstones found stratigraphically below the Monterey shale at Canara Springs and at Temblor, both on the western side of the San Joaquin Valley, on the eastern slopes of the Mount Diablo Range north of Coalinga, Fresno County, California. It was named by Frank M. Anderson.²⁰ It has since been found to be quite widespread over the southern part of California and its marine correlative is known from Oregon²¹ and Washington.²²

It may be noted that, although F. M. Anderson²³ described from the Miocene twenty-four new species, listing in addition, under his descriptions of new species, four previously named forms, at least twenty were found by him only at the Kern River Miocene locality, Kern County; four only at Coalinga, Fresno County; one only at La Panza, San Luis Obispo County; with but two only at the type section of the Temblor. But two typically Miocene species were found to be common to the Kern River beds and the type Temblor, which he correlated. It is unfortunate that we must look to the

¹⁹ HERTLEIN, L. G. and JORDAN, E. K., Paleontology of the Miocene of Lower California, Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, 1927.

²⁰ ANDERSON, F. M., Stratigraphic Study in the Mount Diablo Range of California, Proceedings of the California Academy of Sciences, 3d ser., Vol. 2, No. 2, p. 170, 1905.

²¹ HOWE, HENRY V., Astoria: Mid-Tertic Type of Pacific Coast, Pan-American Geologist, Vol. 45, No. 4, p. 295, 1926.

SCHENCK, H. G., Marine Oligocene of Oregon, University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 16, No. 12, p. 456, 1927.

²² PALMER, R. H., Geology and Petroleum Possibilities of the Olympic Peninsula, Washington, Bulletin of the American Association of Petroleum Geologists, Vol. 11, No. 12, p. 1321, 1927.

²³ Stratigraphic Study in the Mount Diablo Range of California, as previously cited.

Kern River Miocene for a typical Temblor fauna, which formation apparently occupies a similar stratigraphic position with the type Temblor.

A few years later Ralph Arnold²⁴ described from the Santa Monica Mountains of Los Angeles County a few new Temblor species. In addition to Anderson's and Arnold's new species, Conrad²⁵ and Gabb²⁶ had already years previously described numerous Miocene forms now known to occur in the Temblor. Ralph Arnold²⁷ in his report on the paleontology of the Coalinga district described additional new Tertiary species, among which were many forms which he erroneously considered to be of Vaqueros age, but which are now known to be of the Temblor formation.

Subsequent papers deal with the occurrences, faunas, and ecologic conditions of the Temblor. Among these is a paper by F. M. Anderson and Bruce Martin²⁸ in which many new species, chiefly from the Temblor formation in the Temblor Basin of Kern County, were described. A year later John C. Merriam²⁹ discussed the inter-regional correlation of the California Miocene of the San Joaquin Valley upon the basis of mammalian remains, some of which came from the Temblor formation. He dated the Temblor as middle Miocene in age.

In the southern part of the state Kew³⁰ mapped the widespread extent of the Temblor in the Santa Monica Mountains of Los Angeles

²⁴ ARNOLD, RALPH, New and Characteristic Species of Fossil Mollusks from the Oil-Bearing Tertiary Formations of Southern California, Proceedings of the U.S. National Museum, Vol. 32, p. 525, 1907.

²⁵ CONRAD, T. A., Pacific Railroad Reports, Vols. 5, 6, 7, 1856, 1857, 1857, respectively.

²⁶ GABB, W. M., Geological Survey of California, Paleontology, Vol. 2, 1869.

²⁷ ARNOLD, RALPH, Paleontology of the Coalinga District, Fresno and Kings Counties, California, U.S. Geological Survey Bulletin No. 396, 1909.

²⁸ ANDERSON, F. M., and MARTIN, BRUCE, Neocene Record in the Temblor Basin, California, and Neocene Deposits of the San Juan District, San Luis Obispo County, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, 1914.

²⁹ MERRIAM, JOHN C., Tertiary Vertebrate Faunas of the North Coalinga Region of California, Transactions of the American Philosophical Society, N.S., Vol. 22, Part 3, 1915.

³⁰ KEW, W. S. W., Geology and Oil Resources of a Part of Los Angeles and Ventura Counties, California, U.S. Geological Survey Bulletin No. 753, 1924.

County from which he listed a comparatively large fauna. The local name "Topanga" was applied to this formation instead of the name Temblor, the formation with which it may be correlated. This was done, as Kew declared, "as the greatest exposure of the series of strata described above within the region covered by this report is in the vicinity of Topanga Canyon, and as the fauna characterizing it has been for a number of years known as the 'Topanga Canyon fauna,' the local name Topanga formation is here adopted for it."³¹ However, since it occupies a stratigraphic position apparently identical with the Temblor formation of the type section, and since it carries a fauna typical of the Temblor, the name "Topanga" may best be dropped and the name Temblor, which was given twenty years before, retained, because there can be little doubt that the Topanga and Temblor represent contemporaneous deposition.

Still further south, Woodford³² described the occurrence of the Temblor in Orange County and established an interesting facies of the Temblor formation. In this paper was listed the fauna of the Temblor from that part of the state. English,³³ shortly later, mapped a considerable extent of the Temblor in the Santa Ana Mountains of Orange County, for which he used the name applied by Kew, that of Topanga, and appended a faunal list as determined by Dickerson.³⁴ Finally, in a recent paper, Hertlein and Jordan³⁵ listed the species collected from the Miocene of Lower California and described the new forms, some of which they recognized as representatives of the Temblor.

That the Vaqueros and Temblor formations are both characterized by the common occurrence in each of *Turritella inczana* Conrad and

³¹ KEW, W. S. W., *ibid.*, p. 48.

³² WOODFORD, A. O., The San Onofre Breccia, Its Nature and Origin, University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 15, No. 7, p. 180, 1925.

³³ ENGLISH, W. A., Geology and Oil Resources of Puente Hills Region, Southern California, U.S. Geological Survey Bulletin No. 768, 1926.

³⁴ DICKERSON, R. E., The Martinez and Tejon Eocene and Associated Formations of the Santa Ana Mountains, University of California Publications, Bulletin of the Department of Geology, Vol. 8, p. 269, 1914.

³⁵ HERTLEIN, L. G., and JORDAN, E. K., Paleontology of the Miocene of Lower California, Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, 1927.

Turritella ocoyana Conrad, respectively, was recognized at an early date. For a long time they were referred in the literature as zones, and named for the distinctive fossil species. These species, which are regarded as index fossils, have never been reported as occurring together and serve as one means of distinguishing the Vaqueros from the Temblor beds.

On the other hand, F. M. Anderson, in his joint paper with Bruce Martin, declared that "it has yet to be shown that the so-called Vaqueros beds of the Salinas Valley are older in time than the Temblor deposits at the base of the Miocene within the Great Valley."³⁶ Since that time, by careful paleontologic and stratigraphic work, the Vaqueros has been shown to possess a very distinctive fauna of a more tropical nature than that of the Temblor and to occupy a lower position in the Tertiary column of California than the latter. The Vaqueros has been found to underlie the Temblor in various parts of the state. Kerr and Schenck³⁷ mapped an area in Ventura County where the Vaqueros underlies the Temblor and overlies the Sespe. Kew³⁸ has recently mapped a conformable sequence of fossiliferous strata on Santa Rosa Island, one of the Santa Barbara channel group, in which both the Vaqueros and the Temblor faunas were represented, separated by a considerable thickness of strata. Hertlein³⁹ has also mapped the occurrence and studied the faunas of this conformable sequence of Vaqueros and Temblor strata on Santa Rosa Island, as well as on San Miguel Island of the same channel group. Elsewhere in California several cases have been noted where an unconformity apparently marks the separation between the Vaqueros and Temblor formations.⁴⁰

³⁶ ANDERSON, F. M., and MARTIN, BRUCE, Neocene Record in the Temblor Basin, California, and Neocene Deposits of the San Juan District, San Luis Obispo County, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 20, 1914.

³⁷ In a manuscript soon to be published.

³⁸ KEW, W. S. W., Geologic Sketch of Santa Rosa Island, Oil Bulletin, Vol. 13, No. 12, p. 1257, 1927. Los Angeles, California.

³⁹ Verbal communication from the results of study now in manuscript, soon to appear in the Proceedings of the California Academy of Sciences.

⁴⁰ KEW, W. S. W., Geology and Oil Resources of a Part of Los Angeles and Ventura Counties, California, U.S. Geological Survey Bulletin No. 753, p. 47, 1924.

R. D. Reed⁴¹ has declared that minerals derived from the Franciscan schists are absent from the Vaqueros but present in the overlying Temblor, a relation which he believed to hold in other areas. This fact had been noted some time before by A. O. Woodford⁴² to be characteristic of the Vaqueros and Temblor. He noted also that a separation of the two formations might alone be made upon the basis of the pebbles of which they were in part composed, since neither contained a single rock common to the other. Another conformable sequence of Vaqueros overlain by Temblor has been described to the writer by W. S. W. Kew as occurring along the coast at the northwest end of the Santa Monica Mountains, twelve miles southeast of Hueneme, Ventura County, California. Many cases are known where the Vaqueros sandstones are immediately overlain by a diatomaceous shale series, recognized generally as Monterey shale, as for example at the type section of the Vaqueros in Vaqueros Canyon, Monterey County. In such instances the lower part of the shale series, at least, is to be correlated with the Temblor both by virtue of its stratigraphic position and its meager megascopic fauna where it has been found. As a consequence, it has now become universally accepted that the two formations are separate and distinct, faunally and stratigraphically characterized.

Some have believed the Vaqueros and the Temblor formations to be of the same age, others as of different ages. Little question remains that the Vaqueros is the older, having been commonly found underlying the Temblor, possibly unconformably, with a much different fauna of more tropical affinities than that of the younger formation. The faunas clearly indicate that they are the products of time difference, not of ecologic response. The relative stratigraphic positions of the two formations, together with their respective faunas, preclude the possibility of their being homotaxial. Some others have believed the two formations to be different facies of the same unit. It seems as if the Temblor were a facies of the Monterey formation, rather than as if the Vaqueros were a facies either of the Monterey or the Temblor. The Vaqueros has been found below the Monterey shale in many parts of the state, but as a distinctive sand-

⁴¹ REED, R. D., *Researches in Sedimentation in 1926-27*, Report of the Committee on Sedimentation, published by the National Research Council, Washington, D.C., p. 77, 1927.

⁴² WOODFORD, A. O., *op. cit.*, p. 180, 1925.

stone formation. On the other hand, the Temblor, if it is not found as an intervening sandstone member between the Vaqueros and the Monterey shale, is represented by part of the latter formation which has in some cases been found to contain a few representatives of the Temblor fauna. Further evidence indicating time differences in the ages of the Vaqueros and the Temblor formations is being studied by the writer and will be presented in a later paper.

Nearly all who have studied the Vaqueros and the Temblor, even from the earliest time, have been in general agreement as to the ages of the formations. The best evidence supporting the interregional correlation of the Temblor was presented and discussed by Merriam⁴³ in a paper in which the occurrence of certain land mammals in the Temblor of the west side of the San Joaquin Valley has been the basis of dating that formation as probably not older than middle Miocene. Kellogg⁴⁴ in a late paper has made use of marine mammals to correlate the Temblor formation with the Helvetian of Europe, of middle Miocene age. If, then, the Vaqueros underlies the Temblor, possibly unconformably, it must occupy a position in the lower Miocene. Vertebrates recently collected from what was considered to be the uppermost part of the Sespe formation, conformably immediately underlying fossiliferous marine Vaqueros, in Ventura County, have been identified with lower Miocene types.

By way of review, it may be said that on the whole the fauna of the Temblor formation is somewhat better known and more fully described than that of the Vaqueros formation. The faunas of both present warm-water aspects in their assemblages of genera. While the fauna of the upper Oligocene, immediately preceding the lower Miocene, was predominantly cool-water in nature, the fauna of the Vaqueros indicates an invasion of many truly tropical genera. The fauna of the middle Miocene, the Temblor, on the other hand, indicates somewhat cooler conditions, more of a warm temperate type, than those of the preceding age, the Vaqueros.

⁴³ MERRIAM, JOHN C., Tertiary Vertebrate Faunas of the North Coalinga Region of California, Transactions of the American Philosophical Society, N.S., Vol. 22, Part 3, 1915.

⁴⁴ KELLOGG, REMINGTON, Study of the Skull of a Fossil Sperm-Whale from the Temblor Miocene of Southern California, Carnegie Institute of Washington, Publication No. 346, p. 5, 1927.

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A list of some of the more important publications bearing upon the present paper, to which the reader may have occasion to refer and which thus far have not been noted in the text, follow:

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- SMITH, JAMES PERRIN, *Geologic Range of Miocene Invertebrate Fossils of California*, *Proceedings of the California Academy of Sciences*, 4th ser., Vol. 3, 1912.
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DESCRIPTIONS OF NEW SPECIES

PHYLUM MOLLUSCA

CLASS GASTROPODA

Subclass ANISOPLEURA

Superorder STREPTONEURA

Order CTENOBRANCHIATA Schwiegger

Suborder PLATYPODA Lamarck

Superfamily Ptenoglossa Gray

Family SOLARIIDAE Chenu

Genus ARCHITECTONICA Bolten, 1798

TYPE: *Solarium perspectivum* Linné*Architectonica compressa* Wiedy, sp. nov.

Plate 9, figures 1, 2

Shell of small size, circular in outline and flatly subconical in shape; spire small, short, low and not prominent. Shell obtusely angulated at the apex, measuring about 120° ; succeeding whorls spirally wound about the earlier ones on nearly the same plane of revolution. There are about five whorls, gradually increasing in size so that one whorl is about twice the size of the same stage of the preceding whorl in diameter. They are flattened, markedly on the under surface, less so on the upper surface where they are gently convex and rise at a low angle from the angulation which is quite sharply rounded. The shell is sculptured on the upper surface of the whorl above the margin by four broad spiral ridges, separated by narrower channeled interspaces. Periphery of the whorl bounded by a fifth ridge which is heavier and more prominently developed. The under side of the whorl is marked by five additional spiral ridges, the inner four of which are more closely spaced than any of the above-described and are separated by only a thin groove. Umbilicus moderately narrow and surrounded on the inner lower margin of the whorl by a rather obscure spiral ridge which is marked by prominent, closely spaced crenulations which are broader at their outer extremities and separated by furrows which are somewhat narrower. All the spiral

ridges are marked by similar crenulations, but the latter reach a much less prominent development on them. The base of the shell is nearly flat. Greatest diameter, 16 mm.; least diameter, 13 mm.; altitude, 7 mm.; diameter of the umbilicus, 4 mm.

Holotype: S.D.S.N.H. type collection, type number 12, from S.D.S.N.H. and L.S.J.U. locality 428. This individual was collected from the south slope of a hillside two miles southeast of El Modena, Orange County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This new species of *Architectonica* differs from any of the known living forms in the waters of this part of the world in being flatter, in having a wider umbilicus, and in the possession of strong incremental lines of growth. It differs from the only living species of the genus on the West Coast, *A. granulata* Lamarck,⁴⁵ from the coast of Lower California and Mexico, in having a much less elevated spire and less pronounced spiral sculpture on the under surface of the whorls.

It may be distinguished from *A. lorenzoensis* Arnold,⁴⁶ in its more prominent sculpturing, in lacking the biangular character of the body whorl at the angulation, in having four instead of three spiral ridges on the upper surface of the whorl, and in possessing a narrower umbilicus. It is more ornate and lower-spined than *A. blanda* Dall⁴⁷ of the Oligocene of Fall Creek, Oregon.

Found associated with this new species were numerous individuals of *Turritella bösei* Hertlein and Jordan and rare individuals of *Trophosycon kernianum* Cooper.

Superfamily **Rachioglossa**

Family NEPTUNEIDAE

Genus **AGASOMA** Gabb

TYPE: **Clavella gravida** Gabb

The following is a list of references to the species of the genus *Agasoma*:

⁴⁵ Conchologia Iconica, Vol. 15, sp. 7, pl. 2, 1864.

⁴⁶ Proceedings of the U.S. National Museum, Vol. 34, p. 374, pl. 33, fig. 10, 1908.

⁴⁷ U.S. Geological Survey Professional Paper No. 59, p. 80, pl. 3, figs. 4, 5, 1909.

- Fusus oregonensis* Conrad, American Journal of Science, 2nd ser., Vol. 5, p. 435, fig. 13, 1848. Now known to be of the genus *Agasoma* Gabb.
- Conrad, American Journal of Conchology, Vol. 1, p. 151, 1865. Assigned to genus *Sycotyphus* of Browne.
- Dall, U.S. Geological Survey Professional Paper No. 59, p. 75, 1909. Assigned as *Ficus (Trophosycon) oregonensis*.
- Schenck, University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 16, No. 12, p. 456, 1927. Listed for first time formally as "*Bruclarkia*" *oregonensis* Conrad. *Bruclarkia* is synonymous with *Agasoma* Gabb.
- Clavella gravida* Gabb, Geology of California, Paleontology, Vol. 2, p. 4, pl. 1, fig. 6, 1869.
- Gabb, Geology of California, Paleontology, Vol. 2, p. 46, pl. 1, fig. 6, 1869. First listed species under the new genus *Agasoma* created to embrace it.
- Cossmann, Essais de Paléoconchologie comparée, Vol. 4, p. 148, 1901. *Agasoma sinuatum* Gabb, p. 148, fig. 41, chosen as the type of *Agasoma* Gabb. *Agasoma gravidum* declared to be an "incomplete *Morio*."
- Merriam, University of California Publications, Bulletin of the Department of Geology, Vol. 3, p. 378, 1904.
- English, University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 10, p. 245, 1914. *Agasoma gravidum* Gabb, p. 251, pl. 25, figs. 7, 8, is specifically designated as the type of *Agasoma* Gabb.
- Clark, University of California Publications, Bulletin of the Department of Geology, Vol. 11, No. 2, p. 182, pl. 22, figs. 1, 3, 5, 1918.
- Cossmann, Essais de Paléoconchologie comparée, Vol. 13, p. 257, 1924. Reiteration that *Agasoma gravidum* is an "incomplete *Morio*."
- Stewart, Proceedings of the Academy of Natural Sciences, Philadelphia, Vol. 78, p. 397, pl. 31, figs. 10, 11, 1926. "*Bruclarkia*" Trask in Stewart; type: *Agasoma gravidum* Gabb. Synonymous with *Agasoma* Gabb; type: *Agasoma gravidum* Gabb.
- Agasoma sinuata* Gabb, Geology of California, Paleontology, Vol. 2, p. 46, pl. 1, fig. 7, 1869.
- Tryon, Structural and Systematic Conchology, Vol. 2, p. 143, pl. 5, fig. 65, 1883.
- Fischer, Manuel de Conchyliologie, p. 627, 1884.
- Cossmann, Essais de Paléoconchologie comparée, Vol. 4, p. 148, 1901. *Agasoma sinuatum* declared to be the type of *Agasoma* Gabb.
- English, University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 10, p. 250, pl. 25, figs. 5, 6, 1914.
- Trask, University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 13, No. 5, p. 157, 1922. *Koilopectera* Trask, gen. nov.; type: *Agasoma sinuatum* Gabb, pl. 8, figs. 2, 3a, 3b, 4a, 4b.
- Stewart, Proceedings of the Academy of Natural Sciences, Philadelphia, Vol. 78, p. 397, 1926. Cossmann's proposal of *Agasoma sinuatum* as the type of *Agasoma* Gabb accepted.
- Agasoma barkerianum* Cooper, California State Mining Bureau Publications, Bulletin No. 4, p. 53, pl. 5, fig. 63, 1894.

- English, University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 10, p. 252, pl. 25, figs. 3, 13, 14, 1914.
- Agasoma santacruzana* Arnold, Proceedings of the U.S. National Museum, Vol. 34, p. 379, pl. 34, fig. 7, 1908.
- English, University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 10, p. 252, pl. 25, figs. 11, 12, 1914. Listed as a varietal form of *Agasoma barkerianum* Cooper.
- Agasoma stanfordensis* Arnold, Proceedings of the U.S. National Museum, Vol. 34, p. 384, pl. 35, fig. 5, 1908. Probably of the genus *Ficus*.
- Agasoma barkerianum* Cooper, var. *clarki* English, University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 10, p. 253, pl. 25, figs. 9, 10, 1914.
- Agasoma columbianum* Anderson and Martin, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 73, pl. 5, figs. 6a, 6b, 1914.
- Agasoma acuminatum* Anderson and Martin, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 73, pl. 5, figs. 4a, 4b, 1914.
- Clark, University of California Publications, Bulletin of the Department of Geology, Vol. 11, No. 2, p. 182, pl. 22, figs. 11, 19, 1918.
- Clark and Arnold, University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 14, No. 5, p. 160, pl. 29, figs. 1a, 1b, 2, 3a, 3b, 1923.
- Agasoma oregonense* Anderson and Martin, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 74, pl. 4, figs. 3a, 3b, 1914. Name preoccupied by *Agasoma oregonense* Conrad. New name proposed by the writer in this paper.
- Agasoma yaquinanum* Anderson and Martin, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 75, pl. 4, figs. 5a, 5b, 1914.

The following is a list of species and varieties of the genus *Agasoma* which various writers have held valid:

- Agasoma oregonense* Conrad
Agasoma gravidum Gabb
Agasoma sinuatum Gabb
Agasoma barkerianum Cooper
Agasoma santacruzanum Arnold (considered as a variety of *A. barkerianum* Cooper, by some)
Agasoma barkerianum Cooper, var. *clarki* English
Agasoma columbianum Anderson and Martin
Agasoma acuminatum Anderson and Martin
Agasoma andersoni Wiedey
Agasoma yaquinanum Anderson and Martin
Agasoma gravidum Gabb, var. *multinodosum* Clark

The genus *Agasoma* has recently been considered by Stewart, with the consequent renaming of the group of *Agasoma gravidum*, by far the commoner of Gabb's original two species upon which he established the genus, under the new generic name *Bruclarkia* (Trask in Stewart). In making this move Stewart accepted Cossmann's⁴⁸ listing of *Agasoma sinuatum* Gabb as the type of Gabb's genus. Cossmann probably derived this belief from Tryon and Fischer, both of whom listed this species as typical of the genus. However, Stewart did not accept Cossmann's inclusion of *Agasoma gravidum* under the genus *Morio*. Cossmann's belief that the latter species was a *Morio*, leaving but one valid species under the genus *Agasoma*, led him to pick that form as the type. This work of Cossmann's was accepted by Stewart upon the basis that Cossmann was the first reviser of the genus *Agasoma*, to whom the rules of nomenclature permit the privilege of picking the type when none was named by the creator of the genus. But Cossmann did not revise the genus in any sense of the word. His apparent unfamiliarity with West Coast forms is evidenced by his failure to consider that two additional forms had some years before been assigned to the genus *Agasoma*, one of which was the cause for the erection of a new subgenus by Cooper. It has been demonstrated that this subgenus does not belong to *Agasoma* and is to be placed under the genus *Ficus*. So Cossmann's chance observations, based upon very short descriptions and meager illustrations in Gabb, do not constitute a revision of the genus.

Even though Cossmann was the first writer formally to list a type for the genus *Agasoma*, his choosing of *A. sinuatum* Gabb as the type is impossible of acceptance, since it is a very rare form and unlike the other forms that have been assigned to *Agasoma*. It appears quite certain that *A. gravidum* Gabb is not to be confused with forms of the genus *Morio*, as Cossmann believed, but must be regarded as typical of the *Agasoma* species. Furthermore, it has always been considered by all West Coast paleontologists that *A. gravidum* is the type of the genus. The naming of *A. gravidum* first, the very common occurrence of that species, together with the rare occurrence of *A. sinuatum* strengthens the validity of that consideration.

English, therefore, being the first to revise the *Agasoma*-like gastropods, and being thoroughly familiar with the paleontology of

⁴⁸ Essais de Paléonchologie comparée, Vol. 4, p. 148, 1901.

the West Coast, acted with judiciousness in formally assigning *A. gravidum* as the type of the genus. The extraneous form *A. sinuatum*, he assigned to a section apart from the typical forms of the genus because it had proven so different from the other *Agasomas*.

Not many years later, Trask recognized that *A. sinuatum* was evidently not congeneric with the type of the genus and proposed for it a new generic name, *Koiolepleura*. Trask, in making this move, greatly clarified an otherwise confused case, preserving for the typical *Agasomas* the name that Gabb had intended. Cossmann⁴⁹ later declared, when he observed this trend of opinion, that his work of an earlier date was apparently overlooked. He also declared that not only was *Koiolepleura* of Trask synonymous with *Agasoma* of Cossmann, but that the new generic name chosen by Trask was pre-occupied among the Echinoids by the generic name *Coclopleurus*. However, in this connection, it may be pointed out, the differences in spelling are sufficiently distinctive between the two to prevent confusion. Several cases exist of an analogous nature, the validity and the authenticity of which have never been questioned.

By verbal communication with Dr. H. G. Schenck, the writer's attention was called to the possible synonymy of *Agasoma* Gabb with *Priscofusus* Conrad,⁵⁰ the type of which was chosen by Dall⁵¹ as *Priscofusus corpulentus* Conrad,⁵² now generally accepted. While Cossmann⁵³ chose *Priscofusus geniculus* Conrad as the type of the genus in discussing its systematic position, Dall was the first to revise the genus and so was privileged to choose the type.

Dall has carefully studied Conrad's type material of *Priscofusus* and made casts of their rock molds. In as much as Conrad's figure of *P. corpulentus* is impossible of identification and diagnosis, Dall found it necessary to employ this means to determine the characters of the type species, and thus of the genus. With Conrad's data, coupled with later examinations of the type material, the characters of the genus and its apparent systematic position as a subgenus of *Fusinus*, family of *Fasciolaridae*, became evident to Dall. The genus

⁴⁹ *Op. cit.*, Vol. 13, p. 257, 1924.

⁵⁰ CONRAD, T. A., *American Journal of Conchology*, Vol. 1, p. 150, 1865.

⁵¹ DALL, W. H., U.S. Geological Survey Professional Paper No. 59, p. 39, 1909.

⁵² CONRAD, T. A., U.S. Exploration Expedition, Atlas to Vol. 10, p. 728, pl. 20, fig. 4, 1849.

⁵³ *Op. cit.*, Vol. 4, p. 8, 1901.

Agasoma, on the other hand, is properly to be included with the genera under the family of *Neptunidae*, as Stewart has indicated. Obviously, then, the genus *Agasoma* is not to be confused with the genus *Priscofusus* Conrad.

***Agasoma andersoni* Wiedey, nom. nov.**

Because of the synonymy existing between *Agasoma oregonense* Anderson and Martin and "*Fusus*" *oregonensis* Conrad, it became necessary to assign a new specific name to the more recently described species. It has been only within very recent time that the proper assignment of Conrad's form to the genus *Agasoma* has been correctly determined. Its first formal listing as a species of that genus was by H. G. Schenck.⁵⁴ Therefore, *Agasoma andersoni* is here proposed as a new name for *A. oregonense* Anderson and Martin.

Named for Frank M. Anderson, who has been a most diligent and energetic pioneer worker in the paleontology of the West Coast.

Family THAISIDAE Dall

Genus **RAPANA** Schumard, 1817

TYPE: **R. bezoar** Linné

***Rapana vaquerosensis* Arnold**

Purpura vaquerosensis Arnold, Smithsonian Miscellaneous Collections, Vol. 50, Publication No. 1780, p. 427, pl. 52, figs. 1a, 1b, 1908.

Thais vaquerosensis (Arnold) Dickerson, University of California Publications, Bulletin of the Department of Geology, Vol. 8, p. 269, 1914.

Thais vaquerosensis (Arnold), Anderson and Martin, Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 44, 1914.

Rapana vaquerosensis (Arnold), Smith, J. P., Proceedings of the California Academy of Sciences, 4th ser., Vol. 9, No. 4, p. 161, 1919.

Thais vaquerosensis (Arnold), English, U.S. Geological Survey Bulletin No. 768, p. 26, 1926.

When Arnold described this species he considered it allied to the genus *Purpura*, especially to the group of *P. triserialis* Blainville and *P. triangularis* Blainville. It remained so assigned in the literature until 1914, when R. E. Dickerson and F. M. Anderson both con-

⁵⁴ SCHENCK, H. G., University of California Publications, Bulletin of the Department of Geological Science, Vol. 16, No. 12, p. 456, 1927.

sidered it to belong to the genus *Thais*. The possibility of a truly tropical oriental genus making its appearance had not been considered. A few years later J. P. Smith corrected the erroneous assignment of Arnold's species and properly assigned it to the genus *Rapana*, yet later authors have perpetuated the error.

Rapana serra Wiedey, sp. nov.

Plate 9, figures 4, 5, 6

Shell greatly variable in size, but attaining lengths of 80 mm. or more. It is pyrula-form with only a moderately elevated spire, which is bluntly conical. Whorls about four. The angulation adjacent to the suture gently anteriorly sloping, with no apparent concavity immediately in front of the suture. The latter is closely pressed against the angle of the preceding whorl, nearly reaching the prominent nodes at the angulation, which generally number about twelve to the whorl even in young individuals. Just posterior to the nodes on the superior surface of the whorl is a slight concavity which soon disappears. Lines of growth pass diagonally posteriorly across the upper surface of the shell to the angulation where they drop nearly vertically to the under side. About twelve prominent spirally revolving lines sculpture the upper side of the whorl and are themselves separated by much narrower sharply incised channels. The lower side of the whorl bends slightly acutely back and is marked by a few spiral lines similar to those on the upper side of the whorl. One-third the distance down the whorl from the angulation is another spiral ridge which is very coarse, prominent, and periodically marked by a series of nodes smaller than those on the angulation. They are of about the same number. Slightly below the middle of the whorl is a third spiral ridge, a little less prominent than the ones above, and only slightly rugose. Separating this from the next ridge above are two or three of the finer spiral lines. Below this last large ridge, on the lower half of the whorl, are many wavy, scalloped, coarse, thread-like ridgelets which parallel the long axis of the shell. Columella distinctly twisted and prominently recurved, with the lower portion spreading over a moderately narrow canal. Columella strongly sculptured by incremental lines of growth. Altitude, 70 mm.; breadth at greatest diameter, 53 mm.; altitude of the body whorl, 60 mm.

Holotype: S.D.S.N.H. collection, type number 13, from S.D.S. N.H. and L.S.J.U. locality 442. Collected from Kavanaugh Creek,

a short distance north of its confluence with the Nacimiento River, San Luis Obispo County, California. L. Wm. Wiedey, collector. Vaqueros formation, lower Miocene.

Two other authentic species of *Rapana* are known from the Miocene of the West Coast, both probably of Vaqueros age. From the earlier described, *R. vaquerosensis* Arnold,⁵⁵ this new species is distinguished by its much lower spire, the possession of minor spiral ridges between the heavy ridges which support the nodes, the possession of another row of nodes below the angulation, with the tendency of the nodes on the angulation to be sharper and more prominent. From the later described species, *R. imperialis* Hertlein and Jordan,⁵⁶ it differs in having less broadly inflated body whorl, less prominently projecting nodes, and less recurving of the columella, with a narrower sulcus. This later named species has only been reported from the Miocene of Lower California. Named in honor of Fra Junipero Serra in recognition of his services to California.

Superfamily **Taenioglossa**

Family TURRITELLIDAE Gray

Genus **TURRITELLA** Lamarck, 1799

TYPE: **Turbo terebra** Lamarck

Turritella bösei Hertlein and Jordan

Plate 10, figure 7

Plate 11, figures 1, 2, 3, 5, 6

Turritella ocoyana Conrad, Arnold, Ralph, Proceedings of the U.S. National Museum, Vol. 32, p. 526, pl. 51, figs. 7, 8, 9, 1907. Not *T. ocoyana* of Conrad (Pacific Railroad Reports, Vol. 5, p. 329, pl. 8, figs. 73, 73a, 73b, and (?) unnumbered figure, 1856).

Turritella ocoyana Conrad, Eldridge, G. H., and Arnold, Ralph, U.S. Geological Survey Bulletin No. 309, p. 148, pl. 41, figs. 7, 8, 9, 1907. Not *T. ocoyana* of Conrad (*op. cit.*).

⁵⁵ ARNOLD, RALPH, Smithsonian Miscellaneous Collection, Vol. 50. Publication No. 1780, p. 427, pl. 52, figs. 1a, 1b, 1908.

⁵⁶ HERTLEIN, L. G., and JORDAN, E. K., Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, p. 631, pl. 20, fig. 1, 1927.

Turritella ocoyana Conrad, Arnold, Ralph, U.S. Geological Survey Bulletin No. 396, p. 18, pl. 8, fig. 1, 1909. Not *T. ocoyana* of Conrad. Fig. 2, *loc. cit.*, apparently is *T. ocoyana* Conrad (*op. cit.*).

Turritella ocoyana Conrad, Hertlein, L. G., and Jordan, E. K., Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, p. 642, pl. 19, fig. 2, 1927. Not typical *T. ocoyana* Conrad (*op. cit.*).

Turritella bösci Hertlein, L. G., and Jordan, E. K., Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, p. 634, pl. 21, figs. 1, 2, 1927.

Turritella bösci Hertlein and Jordan was named for a distinctive form which possessed a sharp carina at the base of the whorls with a slight concave rounding of the whorl above, occurring in and with the *Turritella ocoyana* fauna, Temblor in age, in Lower California.

The following is the original description of *T. ocoyana* Conrad:

Volutions 13 or 14, straight at the sides; rounded at base, and having well-marked revolving lines, base broad; volutions suddenly tapering to apex.

Conrad's figures and description of *T. ocoyana* are very lucid. That he considered as the typical form of this species that with the rounding of the whorls at the base cannot be doubted, after a careful analysis of his statements and figures. So it seems apparent that *T. bösci* is a separate and distinct species from *T. ocoyana*, as the differences appear to be specific.

Both Hertlein and Jordan, following the popular trend in the conception of Conrad's species, sought to differentiate their new species from a form which is, doubtless, conspecific with it and somewhat intermediate in character. This intermediate form they have figured in their paper. The earlier whorls of this figured specimen⁵⁷ exhibit the characteristics of the above-named newer species, while the later, perhaps gerontic whorls, more closely approach the typical form of Conrad's in shape. It at once led the writer to doubt the validity of the new species and to consider it but a variant form of the older named species, that of Conrad. But by careful examination of many specimens from the same stratigraphic position, from numerous scattered localities, it became evident that the form with the sharp carina is specifically separable from that with the rounding of the base of the whorl, both of which compose rather distinctive groups. Individuals intermediate between the two can be found.

Most of the specimens already figured and thought to be conspecific with *T. ocoyana* Conrad, do not appear to conform entirely with the

⁵⁷ *Op. cit.*, pl. 19, fig. 2.

type description of that species, but seem more closely allied with *T. bösci* Hertlein and Jordan. These figures may be seen by consulting the references given in the synonymy of the latter species.

On the accompanying plates 10 and 11 are figured both the reproductions of Conrad's original type figures and other commonly occurring Temblor Turritellas. Figures 2, 4, 5, 9, plate 10, are Conrad's originals reproduced. Figures 1, 3, 8, plate 10, are forms identified with that species. All clearly show the rounding of the base of the whorls, which are flatly to slightly convexly rounded above, characteristic of *T. ocoyana* Conrad. Figures 1, 2, 3, 5, plate 11, are forms nearly identical with the types of *T. bösci* Hertlein and Jordan, one of which is figured on the same plate, figure 6. They exhibit the projecting carina with the concave rounding of the whorl above, characteristic of that species.

Turritella inezana Conrad, var. **pertumida** Wiedey, var. nov.

Plate 12, figures 1, 6

Shell large, highly turreted; sides very gently sloping toward the apex, which, apparently, is very acute. Whorls numbering six or more, prominently convexly inflated in shape. The succeeding whorls increase very slowly in diameter. The younger whorls are less prominently inflated, while the later whorls reach a high degree of inflation with the point of greatest diameter at or above the center of the whorl. Suture more shallowly impressed between the earlier than the later whorls, where it is rather deep. Sculpture consists of wavy incremental lines of growth, heavier on the later whorls where they become very prominent. Length of the type (upper portion of the shell is broken away), 110 mm.; breadth of the youngest whorl, 7 mm.; breadth of the latest whorl, 28 mm.

Holotype: S.D.S.N.H. type collection, type number 14, collected from S.D.S.N.H. and L.S.J.U. locality 441. Collected from the head of the Canyon de Piedra, about five miles east of San Luis Obispo, San Luis Obispo County, California. *Paratype*: L.S.J.U. type collection, type number 418. R. B. Moran and L. Wm. Wiedey, collectors; Vaqueros formation, lower Miocene.

This new varietal form, which is rather common at the type locality, is to be distinguished from *T. inezana* Conrad by possessing prominently convexly inflated whorls with strong incremental sculpture, while Conrad's species exhibits a flattened whorl without strong

incremental sculpture but with the faint development of a carina and indistinct revolving ridges. Figures 2, 3, 7, plate 12, are considered closely allied with *T. inczana* Conrad, showing the specific characters.

Turritella ocoyana Conrad

Plate 10, figures 1, 2, 3, 4, 5, 6, 8, 9

Turritella ocoyana Conrad, Pacific Railroad Reports, Vol. 5, p. 329, pl. 8, figs. 73, 73a, 73b, and (?) unnumbered figure, 1856.

Turritella wittichi Hertlein and Jordan, Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, p. 635, pl. 21, figs. 3, 4, 1927.

The type of *Turritella wittichi* Hertlein and Jordan has been carefully compared with the types of *T. bösei* and material identified as *T. ocoyana* Conrad by Hertlein and Jordan. A figured specimen in the reference above thought by them to be the latter species can be shown probably to be conspecific with *T. bösei*, though somewhat intermediate in character with the typical form of *T. ocoyana* Conrad. *T. wittichi* falls into this intermediate series with affinities close to *T. ocoyana* Conrad, though the earlier whorls of the type specimen show the carina, characteristic of *T. bösei*, moderately well developed.

Figure 6, plate 10, is a rephotograph of the form considered as the type of *T. wittichi*. Related *Turritellas* are figured on the same plate.

Turritella variata Conrad

Plate 12, figures 5, 8

Turritella variata Conrad, Pacific Railroad Reports, Vol. 7, p. 195, pl. 8, fig. 5, 1857.

The following is the type description of this species as given by Conrad in the reference above.

Subulate, volutions with straight sides, each with 4 to 6 revolving prominent ribs, body whorl with a broad furrow revolving above the angle of the base.

The following is the discussion by Conrad, accompanying his description of the foregoing species.

A variable species; one specimen of which shows two revolving lines on the upper part of each whorl distant from three equidistant ribs beneath, all nearly or quite equal in size. Others have six unequal equidistant ribs; but I believe the species is always excavated at the base.

It becomes quite apparent from examination of the type descrip-

tion and the type figure, reproduced from Conrad's original on plate 12, figure 5, of this paper, that the forms which have been commonly assigned to *T. variata* Conrad cannot be conspecific with that form. These may be seen by consulting the references to the synonymy given on page 122 of this paper and figures 7 and 8, plate 11. It becomes more evident that such is the case when it is considered that the type of *T. variata* came from the Santa Inez Mountains, evidently with *T. inezana*, the Vaqueros marker, while all of the forms yet identified with the species in question have been secured from the Temblor formation with the commonly occurring and associated form, *T. ocoyana*, but never in the Vaqueros with *T. inezana*. Arnold⁵⁸ reported that he had collected from the west end of the Santa Inez Mountains the "young" of *T. variata* Conrad; but at what localities or in what associations remain unstated.

By careful examination of great numbers of *Turritellas* from the Vaqueros formation, some of which were collected from the type region of *T. inezana* and *T. variata*, the writer was able to clearly determine and separate Conrad's two species here discussed. Considering the geologic and geographic occurrence, the figure, description, and discussion given by Conrad, the form figured as number 8, plate 12, of the accompanying illustrations is doubtlessly the one to be considered conspecific with *T. variata* of Conrad. While the type figure is admittedly poor, it nevertheless illustrates the tendency toward the tabulation at the top of the whorl, besides the general shape and sculpture of the whorl.

Apparently the form figured by Arnold as the type of *T. inezana* Conrad, var. *sespeensis* Arnold⁵⁹ is more closely related as a variety of *T. variata* Conrad. Arnold's type figure seems inverted and while rather featureless, it may be made to conform to the type description and is possible of recognition. Figure 4, plate 12, is a photograph of a better specimen from near the type locality.

It has been deemed apropos to call attention to the error perpetuated in the identification of Conrad's species, *T. variata*, after painstakingly determining that such was the case. Since the forms formerly identified with Conrad's species now remain without a specific name, it becomes necessary to propose a new specific designation.

⁵⁸ ARNOLD, RALPH, Smithsonian Miscellaneous Collections, Vol. 50, Publication No. 1780, p. 421, 1908.

⁵⁹ Proceedings of the U.S. National Museum, Vol. 32, p. 532, pl. 51, fig. 6, 1907.

***Turritella temblorensis* Wiedey, sp. nov.**

Plate 11, figures 4, 7, 8, 9

Turritella variata Conrad, Arnold, Ralph, Proceedings of the U.S. National Museum, Vol. 32, p. 526, pl. 51, figs. 7, 8, 9, 1907. Not *T. variata* of Conrad (Pacific Railroad Reports, Vol. 7, p. 195, pl. 8, fig. 5, 1857).

Turritella variata Conrad, Eldridge, G. H., and Arnold, Ralph, U.S. Geological Survey Bulletin No. 309, p. 147, pl. 41, figs. 10, 11, 12, 1907. Not *T. variata* of Conrad (*op. cit.*).

Shell of moderate size; highly turriculate. Sides of the shell slope rather quickly to the apex, which is not sharply acute, giving the shell the tendency to appear short and thick-set. Whorls number six or more, very convexly inflated. Increase in size in successively older whorls not great. The whorls are marked by a very prominent, sharp carina at about their centers, sometimes falling slightly below. Sides of whorl generally form obtusely angular carina. The upper and lower sides of the whorl slope flatly or slightly concavely away from the carina to the sutures which are only perceptibly depressed. Surface sculpture consists of sharp, prominent, spirally revolving ridges, of which one accentuates the carina, another evenly divides the inward sloping, under side of the whorl. Above the carina are found from two to five similar ridges which are less prominent and more irregularly spaced.

Holotype: S.D.S.N.H. type collection, type number 15, from S.D.S.N.H. and L.S.J.U. locality 425. Collected from the small canyon trending westward from the head of Dry Canyon, at the base of the east-west divide, two miles south of Calabasas, Calabasas quadrangle, Santa Monica Mountains, Los Angeles County, California. *Paratype*: L.S.J.U. type collection, type number 419. *Paratypes*: C.A.S. type collection, type numbers 2984 and 2985. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

T. bösei Hertlein and Jordan⁶⁰ is the only form which in some individuals bears a similarity to this species, but there is no difficulty in separating the two. The position of the carina in *T. bösei* is always near the base with the long flattened or concave slope of the whorl above, while in this new species it is nearly at the center, with the relatively short area above and below sloping flatly or concavely to the sutures. The spirally revolving ridges in *T. bösei* are more rounded and less prominent.

⁶⁰ Proceedings of the California Academy of Sciences, 4th ser., Vol. 16, No. 19, p. 634, pl. 21, figs. 1, 2, 1927.

Turritella montereyana Wiedey, sp. nov.

Plate 21, figures 2, 3

Shell very large, highly turreted, sides sloping moderately toward the apex. Whorls number seven or more. Earlier ones are flat-sided, while the later whorls become markedly convexly rounded. Suture very shallowly impressed in the younger portion of the shell, becoming more deeply impressed with the growth of the individual until in the older specimens it is very deep. The principal sculpturing consists of about four spirally revolving ridges, approximately equally spaced. They are marked by very fine and closely spaced nodes which seem to appear at the points where the growth lines intersect the ribs. In some cases the interspaces between the ribs are sculptured by a very fine single, or paired set of riblets, similar in character to the heavier ribs. Length of type (broken specimen), 102 mm.; breadth of top whorl, 12.5 mm.; breadth of bottom whorl, 37 mm.

Syntype: S.D.S.N.H. type collection, type number 51, from S.D.S.N.H. and L.S.J.U. locality 447. Collected from a locality in the Bryson quadrangle about 1.5 miles south of the San Antonio River in Sec. 3, T. 24 S., R. 8 E., Monterey County, California. *Syntype*: L.S.J.U. type collection, type number 435. W. F. Loel, collector; Monterey formation, middle Miocene.

From *Turritella variata* Conrad (plate 12, figure 5) this new species may be distinguished by its lacking the prominent collar-like ridge which marks the upper part of the whorls and by lacking the distinct excavation between the two bottom ribs at the base of the whorls. *Turritella inezana* Conrad (plate 12, figures 1, 2, 3, 4, 6, 7), besides being a more slender form, lacks the sculpturing of this new species.

Superfamily **Toxoglossa** Troschel

Family CONIDAE Adams

Genus **CONUS** LinnéTYPE: **C. marmoreus** Linné**Conus juanensis** Wiedey, sp. nov.

Plate 9, figure 3

Shell of small size; elongate conical in outline, with a moderately elevated spire. Whorls, about six, rounded, the succeeding increasing

but slowly in size. Apical angle slightly acute, being a little under ninety degrees. Whorls nearly flat on their sides, each with a sharp shoulder at their angulation above which the whorl tends to be slightly tabulate or concavely curved. Apex sharp and approximately central. The suture is visibly depressed. The aperture is moderate in width and nearly straight. Surface sculptured only by fine incremental lines of growth. Length, 26 mm.; breadth, maximum, 16 mm.; height of spire, about 10 mm.

Holotype: S.D.S.N.H. type collection, type number 16, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east side of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This new species of *Conus* is resembled most closely by a form from the Kern River Miocene, of Temblor age, *C. owenianus* F. M. Anderson.⁶¹ It may be distinguished from the latter by lacking the prominent spiral sculpture which characterizes it. This new form also has a more sharply angulated spire of greater height than the Kern River form. Upon examination of more extensive collections of both of these compared species, sufficient variation of the Kern River form to embrace this group of individuals might be shown. It is also resembled by *C. interruptus* Broderip⁶² of the living cones of the Gulf of California in having a similar spire, but, for shells of corresponding stages of growth, the latter has a much higher body whorl than the fossil species.

Found associated with this form were: *Agasoma barkerianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongena californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione temblorensis* F. M. Anderson, *C. panzana* Anderson and Martin, *Clementia pertenuis* Gabb, *Dosinia mathewsonii* Gabb, *Pecten andersoni* Arnold.

⁶¹ Proceedings of the California Academy of Sciences, 3d ser., Vol. 2, No. 2, p. 201, pl. 15, figs. 58, 59, 1905.

⁶² Conchologia Iconica, Vol. 1, pl. 22, sp. 125, 1843.

CLASS PELECYPODA

Order PRIONODESMACEA Dall

Suborder FILIBRANCHIATA Dall

SECTION TAXADONTA Neumayr

Superfamily Arcacea Deshayes

Family ARCIDAE Dall

Genus ARCA (Linné) Lamarck, 1799

TYPE: *A. noae* Linné*Arca sespeensis* Wiedey, sp. nov.

Plate 13, figure 1

Shell moderately small, trapezoidal, quite inequilateral and somewhat gibbose. Posterior dorsal margin short, dropping nearly straight down from under the beak. It is quite sharply rounded at the extremity, and has a long, gently convex ventral margin. The posterior extremity is sharply rounded to the anterior dorsal margin which slopes approximately straight down from the beak. Umbo large, prominent, rather broad, and flattened. The beak is large, posterior, blunt, incurved, and pointed anteriorly. Cardinal area of moderate size, only gently depressed. Sculpture consisting of about nineteen ribs which are prominently elevated and sharply rounded, separated by channels of about equal width which are themselves rounded. Concentric growth lines faint and indistinct. Length, 32 mm.; breadth, 25 mm.; height of one valve, 13 mm.

Holotype: right valve; S.D.S.N.H. type collection, type number 17, from S.D.S.N.H. and L.S.J.U. locality 407. This form was secured from well up on the south wall of the Little Sespe River canyon, just above its confluence with the Big Sespe River, Ventura County, California. L. Wm. Wiedey, collector; Vaqueros formation, lower Miocene.

This new species of *Arca* differs from other known Arcas of the West Coast region in the possession of a broad and thinly compressed umbo with relatively slight convexity of the valve.

Associated with this new form were *Turritella inezana* Conrad, var. *sespeensis* Arnold, *Arca hamelini* Wiedey, sp. nov., *Pecten sespeensis* Arnold, *Ostrea* sp., and *Balanus* sp.

***Arca hamelini* Wiedey, sp. nov.**

Plate 13, figure 2

Shell small, subtrapezoidal, distinctly inequilateral, equivalve, and convexly inflated. The anterior dorsal margin not long, moderately straight with the anterior extremity bluntly rounded. The basal margin is quite long and has a tendency toward parallelism with the hinge line. The posterior extremity more broadly rounded above than below. The posterior dorsal margin is short and nearly straight. The umbones are prominent, large, angular, and elevated, with the umbonal ridge quite well defined. Beak small, well anterior, prominent, sharply pointed, incurved, elevated, prosogyrous, and widely separated in combined valves. The sculpture consists of about sixteen ribs which are high, narrow, and rounded, separated by flattened channels which are distinctly much broader. Where the growth lines cross the ribs there is a tendency to form rugose sculpture, more markedly toward the extremity of the disk. The cardinal area is large, prominent, and moderately depressed. Length, 28 mm.; breadth, 20 mm.; height of one valve, 13 mm.

Holotype: left valve; S.D.S.N.H. type collection, type number 18, from S.D.S.N.H. and L.S.J.U. locality 407. This form was collected from high up on the south wall of the Little Sespe River canyon, a short distance above its confluence with the Big Sespe River, Ventura County, California. L. Wm. Wiedey, collector; Vaqueros formation, lower Miocene.

This *Arca* species will not be confused with any known fossil or living species of the West Coast, because of its distinctively high, sharp umbo and its few and narrow, widely spaced ribs. Its closest resemblant form is a living species from Japanese waters, *A. granosa* Linné,⁶³ but the fossil form has a higher and more strongly prosogyrous umbo which is much sharper than in the living form. Gerontic forms of the living species show greater resemblance to the fossil form.

This new species was found at the same locality with *A. sespensis* Wiedey, sp. nov., associated with *Turritella inczana* Conrad, var. *sespensis* Arnold, *Pecten sespensis* Arnold, *Ostrea* sp., and *Balanus* sp.

Named for Mr. D. F. Hamelin, in appreciation of his valued aid to the writer at all times.

⁶³ Conchologia Iconica, Vol. 2, pl. 13, sp. 15a, 15b, 1844

Arca lakei Wiedey, sp. nov.

Plate 13, figures 4, 5

Shell subquadrate in outline and of moderate size, but distinctly inequilateral and quite gibbose. The anterior dorsal margin short and straight, gently sloping. The anterior dorsal extremity broadly rounded to the basal margin which is less convexly rounded. The posterior dorsal extremity is quite sharply rounded, more narrowly below than above. Posterior dorsal margin short and straight to gently sloping. Umbones prominent, large, elevated, and incurved. The beaks are of moderate size, anteriorly situated, quite sharp, incurved and close-set. The cardinal area is not large and is only gently depressed. Sculpture consists of twenty-five ribs which are low and flattened. The ribs generally have on their surface three longitudinal striations which present the appearance of dividing the ribs into riblets, separated by thread-like channels. The interspaces between the ribs are slightly narrower than the ribs and are flatly channeled. Concentric lines of growth apparent but not prominent. Length, 38 mm.; breadth, 33 mm.; height of both valves, 33 mm.

Holotype: S.D.S.N.H. type collection, type number 19, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east side of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This species may be distinguished from *Arca devincta* Conrad⁶⁴ by its greater gibbosity and less elongate form. It is differentiated from *A. osmonti* Dall⁶⁵ by its much less flattened umbones and more quadrate form. It differs from *A. multicosata* Sowerby⁶⁶ in possessing a more rounded ventral margin and the tendency of the ribs to become very flattened and split. It also has a relatively longer hinge line than the foregoing form.

Found associated with this species were: *Agasoma barkerianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongenina californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione temblorensis* F. M. Anderson, *C. panzana* Anderson and Martin, *Clementia pertenuis* Gabb, *Dosinia matthewsonii* Gabb, *Pecten andersoni* Arnold.

⁶⁴ U.S. Geological Survey, Professional Paper 59, p. 109, append. 1, p. 155, 1909.

⁶⁵ University of California Publications, Bulletin of the Department of Geology, Vol. 4, p. 90, pl. 8, figs. 2a, 2b, 1904.

⁶⁶ Proceedings of the U.S. National Museum, Vol. 32, pl. 48, fig. 1, 1907.

Named for Mr. M. E. Lake in recognition of his very valuable services to the writer while in the field.

Arca rivulata Wiedey, sp. nov.

Plate 13, figure 3

Shell of small size, subquadrate in outline, quite inequilateral and rather convex. Anterior dorsal margin short, sloping quickly to the extremity, which is sharply rounded above, more so below. The basal margin gently convexly rounded to the posterior dorsal extremity which appears to be quite sharply rounded to its adjacent margin. The latter is moderately long and slopes down quite straight from the beak. Umbo prominent, elevated, and incurved. The beak is small, prominent, situated anteriorly, sharp, and distinctly prosogyrous. The sculpture consists of about twenty ribs which are rounded, prominently elevated, and separated by slightly narrower, flatly channeled interspaces. Ribs quite regularly rilled by concentric waves which do not sculpture the interspaces. Rilling is more marked toward the margins of the disk. The cardinal area is apparently small and only slightly depressed. Length, about 15 mm.; breadth, 13 mm.; height of a single valve, 7 mm.

Holotype: left valve; S.D.S.N.H. type collection, type number 20, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east side of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. Merrill E. Lake, collector; Temblor formation, middle Miocene.

This new species of *Arca* differs from other species of the genus from the West Coast in being much smaller, more regularly rounded, more nodosely ribbed, of shorter relative hinge line. It is resembled slightly by the living form *A. labiata* Sowerby,⁶⁷ but is less equilateral and more gibbose about the umbo when forms of the same size are compared.

Forms found with this new species were identified as: *Agasoma barkerianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongena californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione temblorensis* F. M. Anderson, *C. panzana* Anderson and Martin, *Clementia pertenuis* Gabb, *Dosinia mathewsonii* Gabb, *Pecten andersoni* Arnold.

⁶⁷ Conchologia Iconica, Vol. 2, pl. 1, sp. 7, 1844.

Arca galei Wiedey, sp. nov.

Plate 13, figure 8

Shell of moderate size, subtrigonal in outline, distinctly inequilateral and quite convexly inflated. The anterior dorsal margin short and gently convexly curved to the anterior dorsal extremity, which is very sharply rounded to the basal margin. The latter is broadly convexly rounded. Posterior dorsal extremity angularly truncated to the posterior dorsal margin which is nearly straight and slopes abruptly. Umbo large, prominent, angular, elevated, and situated anteriorly. Beak slightly incurved, sharp, and prosogyrous. A distinct shoulder is formed at the posterior side of the umbo, extending from the beak to the posterior extremity, which causes the posterior dorsal area to be separated from the main body of the shell at nearly a right angle. The upper part of the posterior dorsal area appears distinctly folded under the beak. The sculpture consists of about twenty strong ribs, separated by narrower channeled interspaces. The ribs are rippled by concentric waves which are not apparent in the interspaces. Cardinal area inaccessible but apparently not large, sunken deeply below the beak. Length, 25 mm.; breadth, 18 mm.; thickness of a single valve, 9 mm.

Holotype: left valve; S.D.S.N.H. type collection, type number 21, from S.D.S.N.H. and L.S.J.U. locality 427. This species was collected from Benedict Canyon about four and one-half miles south of the San Bernardino Base Line on the east side of the canyon, about one hundred feet above the bottom. The locality is also about four miles north and east from Sawtelle, Los Angeles County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This new species of *Arca* differs from all other observed *Arca*s of the West Coast in possessing a sharp shoulder in the posterior portion of the valve which separates the posterior dorsal area from the main body of the shell. Its sharp umbo and its extended, less regularly rounded outline also serve as means of distinguishing it. From the fossil form *A. sespeensis* Wiedey, sp. nov., it may be separated by its relatively higher and sharper umbo which is somewhat flattened and more prosogyrous.

Found occurring with this new species were: *Turritella ocoyana* Conrad, *Chione temblorensis* F. M. Anderson, *Clementia pertenuis*

Gabb, *Macoma nasuta* Conrad, *Panope generosa* Gould, and *Pteria*, sp. nov. (undescribed).

This species is named for Mr. H. A. Gale, whose encouragement has been greatly appreciated during this work.

***Arca impavida* Wiedey, sp. nov.**

Plate 14, figures 2, 3

Shell moderately large, trapezoidal in outline, nearly as broad as long, distinctly inequilateral and broadly convexly inflated. Anterior dorsal margin not long, sloping gently convexly at nearly a right angle from the hinge line to the extremity which is very broadly rounded. Basal margin nearly parallel and equal in length to the hinge line. The posterior extremity is quite sharply rounded to allow the posterior dorsal margin, which is straight, to pass acutely back from the extremity to the hinge line. Umbo very large, broad, flattened, and abruptly rounded at the anterior and posterior portions. The beak is broad, obtuse, situated toward the anterior portion of the shell and slightly prosogyrous, elevated gently above and slightly overhanging the hinge line. The sculpture consists of about twenty-seven flattened ribs, approximately equal in width to the interspaces and only gently elevated. They sometimes have a tendency to split. Incremental sculpture strong, with numerous fine, closely spaced growth lines. The hinge line is less than four-fifths the length of the shell and is weakly divided near its center to present a shorter anterior series than posterior series of teeth. They are irregularly spaced, finer toward the central part of the hinge, coarser toward the extremity, with the coarser teeth of the posterior series markedly chevron shaped. About twenty-two teeth make up the anterior series and about twenty-five, the posterior series. Cardinal area about one-fifth as broad as long, sculptured by seven chevron-shaped grooves, which are quite regularly spaced. The apices of the chevrons fall between the beak and the constriction of the hinge, giving the chevrons a shorter and more steeply sloping anterior portion. Length, 55 mm.; breadth, 42 mm.; thickness of a single valve, 19 mm.; length of hinge line, 40 mm.

Holotype: right valve; L.S.J.U. type collection, type number 436, collected from S.D.S.N.H. and L.S.J.U. locality 442. This new species was collected from the well-known Barker's Ranch Temblor locality of Kern County, California. W. H. Ochsner, collector; Temblor formation, middle Miocene.

This new form is most closely resembled by *A. osmonti* Dall⁶⁸ but possesses a much broader and more flattened umbo, a relatively longer hinge line and several more grooves on the cardinal area. This species is to be separated from *A. devincta* Conrad⁶⁹ by having, generally, fewer ribs, less inequilateral shape, a relatively longer hinge line, greater number of grooves on the cardinal area, and by lacking the transverse riblets, or striations, on the outer portions of the cardinal area.

***Arca perdisparis* Wiedey, sp. nov.**

Plate 13, figure 6, Plate 14, figure 1

Shell moderately small, elliptical in outline, with the posterior end broader than the corresponding anterior end. It is very inequilateral and only slightly convexly inflated. Anterior dorsal margin very short, passing in a gently rounded manner to the basal margin which is very long and nearly straight, forming a low angle with the hinge line. Posterior dorsal extremity quite broadly rounded to the margin, which is but slightly rounded. Umbo narrow, distinctly elevated above the main body of the shell in a long, regularly rounded ridge. Beak small, sharp, but prominent, very near the anterior end of the shell and perceptibly prosogyrous. The shell is sculptured by about twenty-eight flattened ribs, of equal or of lesser width than the interspaces. The ribs apparently have little tendency to split. The hinge line is about two-thirds the length of the shell. Length, 36 mm.; breadth, 19 mm.; thickness of a single valve, 5 mm.

Holotype: Left valve; S.D.S.N.H. type collection, type number 23, collected from S.D.S.N.H. and L.S.J.U. locality 443. This form was collected three-quarters of a mile southwest of Zayante Station, Santa Cruz Mountains, Monterey County, California. Ralph Arnold, collector; Monterey formation, middle Miocene.

This new species is most closely resembled by *A. obispoana* Conrad,⁷⁰ a Miocene species, plate 13, figure 7, but may be readily distinguished from that form by being much more inequilateral, very much more elongate, in having a nearly straight basal margin and an elevated narrow umbo. These characteristics may serve to separate

⁶⁸ University of California Publications, Bulletin of the Department of Geology, Vol. 4, pl. 8, figs. 2a, 2b, 1904.

⁶⁹ U.S. Geological Survey Professional Paper 59, p. 109, p. 155, 1909.

⁷⁰ Pacific Railroad Reports, Vol. 7, p. 192, pl. 5, fig. 1, 1857.

this new form from any of the other already known West Coast Tertiary representatives of the genus *Arca*.

***Arca procumbens* Wiedey, sp. nov.**

Plate 13, figures 9, 10, 11

Shell rather small, ovoid in shape, slightly inequivalve, extremely inequilateral, and very convexly inflated. Anterior dorsal margin short, gently rounded, sloping nearly straight down from the hinge line to the extremity which is indistinct and very broadly rounded. Basal margin quite straight, sloping downward toward the posterior dorsal extremity which is greatly produced and more abruptly rounded. The posterior dorsal margin is but gently curved and moderately long, sloping sharply to the extremity. Umbones very large, prominent, greatly elevated, and convexly regularly rounded. Beaks broad, slightly elevated, and widely distant. The shell is sculptured by about thirty narrow, elevated, and rounded ribs which in some cases show a faint tendency to split. The interspaces are generally wider than the ribs and near the dorsal areas may be marked by a median riblet, imperfectly developed. The muscle scars are small but strong. The pallial sinus is parallel to the outer margin of the shell and is located closely to it. The hinge line is about three-quarters the length of the shell and is marked by thirty or more fine, closely spaced teeth. Cardinal area about one-quarter as broad as long, sculptured by ten chevron-shaped grooves quite evenly spaced and which have broadly rounded, instead of angular, apices. The anterior portions of the grooves are somewhat shorter than the posterior portions. Length, 35 mm.; breadth, 28 mm.; thickness of the combined valves, 28 mm.

Syntype: Left valve; S.D.S.N.H. type collection, type number 24, collected from S.D.S.N.H. and L.S.J.U. locality 444. This form was collected from a point five miles north of Yaquina Head, Lincoln County, Oregon. *Syntype*: Right valve; L.S.J.U. type collection, type number 420. H. V. Howe, collector; Miocene.

This new species of *Arca* is only resembled by *A. devincta* Conrad⁷¹ and may readily be separated from that species in being more extended in outline, more inequilateral in shape, in having larger and more prominent umbones, and a relatively larger cardinal area with a greater number of grooves.

⁷¹ U.S. Geological Survey Professional Paper 59, p. 109, p. 155, 1909.

SECTION SCHIZODONTA steinmann

Superfamily Pteriacea Dall

Family PTERIIDAE Meek

Genus PTERIA Stöpoli, 1777

TYPE: *Mytilus hirundo* Lamarck*Pteria hertleini* Wiedey, sp. nov.

Plate 21, figure 1

Shell large, very oblique, lingulaeform, nearly equivalve, very inequilateral, and highly inflated. Anterior dorsal margin quite straight and nearly vertical to the hinge line. This dorsal extremity is terminated in a sharp curve. The basal margin is broadly rounded and seems generally somewhat parallel to the hinge line. The posterior dorsal extremity is more sharply rounded; being quite distant from the beaks it accentuates the oblique form of the shell. The posterior dorsal margin is very long and nearly straight. The umbones are very prominent, highly elevated, very regularly rounded, and acutely angular. The beaks are small, sharp, not conspicuous, and quite distant from one another. The hinge length is about three-fourths the width of the shell and is straight with a broad, moderately deeply excavated ligamental area. The anterior ear is the sharper and the more extended. Length, about 110 mm.; breadth, about 95 mm.; thickness of combined valves, about 70 mm.; length of hinge line, about 75 mm.

Holotype: L.S.J.U. type collection, type number 434, collected from S.D.S.N.H. and L.S.J.U. locality 200. Collected from Sec. 9, T. 20 S., R. 6 E., in the Junipero Serra quadrangle in Los Vaqueros Valley about 0.4 miles upstream from the narrow constriction of the canyon a few miles above its mouth, Monterey County, California. A. W. Ambrose, collector; Vaqueros formation, lower Miocene.

This new species is very distinctive and is resembled but slightly by any of the yet recorded West Coast Tertiary forms of this genus. From *Pteria jordani* Wiedey (plate 14, figure 4; plate 15, figure 3), sp. nov., of the Temblor, it differs in being more convexly inflated, more elongate and extended in outline, and in possessing higher, sharper, and more prominent umbones than the more recent form.

This species is named in honor of Mr. Leo G. Hertlein of the California Academy of Sciences in recognition of his contributions to the paleontology of the West Coast.

Pteria jordani Wiedey, sp. nov.

Plate 14, figure 4; Plate 15, figure 3

Shell quite large, moderately oblique, lingulaeform, slightly inequivalve, inequilateral, and well inflated. Anterior dorsal margin above the hinge line rounded concavely, the anterior dorsal extremity very broadly convexly rounded. The basal margin is a little more sharply rounded toward the posterior dorsal extremity, which is but gently rounded. The posterior dorsal margin slopes nearly straight and is only slightly re-entrant into the main body of the shell adjacent to the hinge line. Umbones large, prominent, broad, convexly well inflated with a poorly defined umbonal ridge passing from the beaks toward the base of the shell, about 45° to the hinge line. Beaks situated at the anterior end of the shell, small, sharp, slightly elevated, and incurved. Since most of the shell has been broken away, the external sculpture is unknown. The hinge line is generally about the length of the shell and is straight, marked in the ligamental area by long, narrow, longitudinal grooves. The posterior ear is the broader, while the anterior ear appears to be the more extended and sharper, being very acutely angular. The shell attains a length of over 100 mm., a breadth of over 95 mm., and a thickness in combined valves of over 55 mm.

Holotype: S.D.S.N.H. type collection, type number 25, collected from S.D.S.N.H. and L.S.J.U. locality 425. This new form was collected at the head of a small canyon trending westward from the head of Dry Canyon at the base of the east-west ridge forming the divide, two miles south of Calabasas, Santa Monica Mountains, Los Angeles County, California. *Paratype*: L.S.J.U. type collection, type number 421. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

Species of this genus have rarely been seen in the Cenozoic formations of the West Coast, exclusive of parts of the Eocene. An abundance of individuals of this new species were found matted together in a thin bed at the locality where they were collected, but have not been commonly seen in the same formation elsewhere. An incomplete individual of another new species was collected by the

writer in a similar stratigraphic position elsewhere in Los Angeles County.

This new species differs from other known fossil forms in its very much greater size and in its more rounded and regular outline. It is approached in similarity by a newly described form, *Pteria hertleini* Wiedey, sp. nov., from the Vaqueros at the type section. The latter species is of similar size, but shows greater sharpness of the umbones, which are themselves much more inflated. In some respects it is resembled by *Pteria peruviana* Reeve,⁷² which ranges from the Gulf of California to Ecuador. The fossil species has not the subquadrate outline nor the short posterior ear much separated from the shell found in the living form.

Found associated with this new species were: *Bulla cantuaënsis* Anderson and Martin, *Cancellaria condoni* Cooper, *Murex topangensis* Arnold, *Calyptrea radians* Linné (= *Trochita costellata* Conrad), *Turritella ocoyana* Conrad, *T. temblorensis* Wiedey, sp. nov., *Clementia pertenuis* Gabb, *Dosinia matheresonii* Gabb.

This species is named in honor of Dr. David Starr Jordan in recognition of his most eminent position in natural sciences.

Superfamily **Ostracea** Goldfuss

Family **OSTREIDAE** Lamarck

Genus **OSTREA** (Linné) Lamarck, 1799

TYPE: **O. edulis** Linné

Ostrea howelli Wiedey, sp. nov.

Plate 15, figures 1, 2

Shell of moderate size. Variable outline, but most forms exhibit a subcircular to subovoid contour. It is very inequivalve and is seldom equilateral. The left valve is the more convex and thick-shelled. In some specimens the dorsal portion is the narrower part of the shell while the basal end is often wider and more broadly rounded. Umbo of the left valve is found in some individuals to preserve the small

⁷² Conchologia Iconica, Vol. 10, pl. 14, sp. 53, 1857.

subcircular shell of the young stages, showing about six prominent, radiating, irregular ribs as the principal sculpturing. Sculpturing on the adult consists of about six prominently elevated, radiating ridges, separated by narrower channels. Ribs show a tendency to divide at different stages of growth in some specimens. Strong, concentric, incremental growth lines become very coarse toward the basal margin. The interior is smooth with the muscle impression very deep, round, and situated in the posterior portion near the dorsal margin. The ligamental pit is robust, moderately long, roundly and deeply channeled. Length from the margin at the hinge to the distant periphery, 90 mm.; breadth, about 60 mm.; thickness of a single valve, 40 mm.

Syntype: Left valve; S.D.S.N.H. type collection, type number 26, from S.D.S.N.H. and L.S.J.U. locality 446. Collected near Sespe Creek, five and one-half miles northeast of Wheeler's Hot Springs, Mt. Pinos quadrangle, Ventura County, California. *Syntype*: Left valve; L.S.J.U. type collection, type number 422. *Syntypes*: Left valves; California Academy of Sciences type collection, type numbers 2981 and 2982. A. Llewelyn Howell, collector; Temblor formation (?), middle Miocene.

This new species of *Ostrea* may not be easily confused with any other known fossil forms because of its very distinctive characteristics. It bears external similarity of outline most closely to *Ostrea vespertina* Conrad,⁷³ but the latter species is much thinner shelled. This new form also possesses a much more powerful hinge and greater arching of the shell than Conrad's species. It shows a slight similarity to *O. titan* Conrad⁷⁴ and *O. titan* Conrad, var. *corrugata* Nomland.⁷⁵ The latter may be separated by its broader resilial pit, relatively smaller muscle impression, and much less prominent sculpture of the shell than found in the new species. Among the living forms there is very little resemblance to this species. So, apparently, it belonged to a group of forms of which there are no, or rare, living representatives.

Named for Mr. A. L. Howell, who collected this new species for the writer.

⁷³ U.S. Geological Survey Bulletin No. 396, p. 77, pl. 24, figs. 4, 5, 1909.

⁷⁴ *Op. cit.*, p. 116, pl. 5, fig. 1; p. 126, pl. 10, fig. 5; p. 128, pl. 11, fig. 2, 1909.

⁷⁵ University of California Publications, Bulletin of the Department of Geology, Vol. 10, No. 18, p. 306, pl. 16, fig. 1; pl. 17, fig. 1, 1917.

SECTION ISODONTA Fischer

Superfamily **Pectinacea** Reeve

Family PECTINIDAE Lamarck

Genus **PECTEN** Müller, 1776TYPE: **Ostrea maxima** Linné

Subgenus CHLAMYS Bolten, 1798

Pecten (Chlamys) erici Wiedey, sp. nov.

Plate 16, figure 1

Shell of large size, subovoid in outline, subequivalve and equilateral, moderately inflated, with the right valve apparently the more convex. The anterior dorsal margin is not long and is straight to the extremity, where it is rounded to the basal margin. The latter portion of the shell is evenly and regularly rounded. Posterior dorsal extremity a little more sharply convexly curved than the corresponding anterior portion. Posterior dorsal margin short and nearly straight, or slightly concave in outline. Umbones narrow and very convexly inflated. The sculpturing on the left valve consists of about thirty prominent ribs, which are rounded and closely spaced. They curve irregularly and a few divide near the basal margins of the shell. The ribs exhibit incremental sculpture only near the basal margins of the disk. The right valve appears to have a few less ribs but is similarly sculptured. The anterior ear is small; the posterior ear is the more extended. The umbonal angle is less than 90 degrees. Length, 58 mm.; breadth, 65 mm.; thickness of the attached valves, about 20 mm.

Holotype: S.D.S.N.H. type collection, type number 27, collected from S.D.S.N.H. and L.S.J.U. locality 406. Collected from the west end of South Mountain where it is truncated by the Santa Clara River, in a grayish-green, firmly indurated sandstone, but a few feet above the river bed, two miles southwest of Santa Paula, Ventura County, California. L. Wm. Wiedey, collector; Vaqueros formation, lower Miocene.

Among the fossil Pectens this new species is most closely resem-

bled by *P. sespeensis*, var. *hydei* Arnold,⁷⁶ but the latter is distinctive in possessing much longer anterior and posterior dorsal margins, which form a smaller umbonal angle. The varietal form is sculptured by nearly ten less ribs which are more subequal. The characteristic paired ribbing of *P. sespeensis* Arnold,⁷⁷ about nine pairs in all, readily serves to distinguish it from the new species, which shows many more individual ribs.

Found associated with this new species were: *Rapana imperialis* Hertlein and Jordan, *R. serrai* Wiedey, sp. nov., *Turritella inezana* Conrad, *Cardium vaquerosensis* Arnold, *Dosinia mathewsonii* Gabb, *Panope generosa* Gould, *Pecten sespeensis*, var. *hydei* Arnold.

This new species is named for Eric Knight Jordan whose untimely death deprived West Coast paleontology of a valued scientist.

Family SPONDYLIDAE Fleming

Genus SPONDYLUS Linné

TYPE: *S. gaederopus* Linné

This tropical genus has until recently passed authentically unrecognized in the California Cenozoic strata. Arnold figured a form which he identified with *Pecten (Himmites) giganteus* Gray,⁷⁸ but which can be shown to be a *Spondylus* species. Very often it is difficult in the fossil forms, without well preserved or sufficient material, to be certain of the generic determination.

Conrad described a new species of *Spondylus* from the Miocene upon the basis of a shell fragment. Gabb later declared this form to be synonymous with *Pecten crassicardo* Conrad and not a *Spondylus* species.

Spondylus perrini Wiedey, sp. nov.

Plate 17, figures 6, 7

Pecten (Himmites) giganteus Gray, Eldridge and Arnold, U.S. Geological Survey Bulletin No. 309, pl. 32, fig. 1, 1907. Not *Lima gigantea* Gray, Annals of Philosophy, N.S., Vol. 9, p. 39, 1825.

⁷⁶ Smithsonian Miscellaneous Collections, Vol. 50, Publication No. 1780, pl. 53, fig. 3, 1908.

⁷⁷ U.S. Geological Survey Professional Paper 47, p. 69, pl. 8, figs. 2, 2a, 3, 1906.

⁷⁸ U.S. Geological Survey Bulletin No. 309, pl. 32, fig. 1, 1907.

Shell large, variable in shape, narrowly ovoid, very inequivalve, slightly inequilateral, and very strongly inflated. Anterior dorsal margin not long, quite straight, sharply truncated at the extremity, curving into the broadly rounded basal margin, which varies in the degree of curvature owing to the irregularity of outline of the shell. Posterior dorsal margin short, curving slightly from its gently rounded extremity to the hinge line. Umbo of the left valve of much greater size than the umbo of the right valve. It is long, narrow, highly arched, and projected very markedly over the corresponding feature of the right valve. Umbo of the right valve, if elevated, is broadly inflated and quite blunt. The beaks are strongly incurved, sharp, and prominent. The sculpturing consists of about twelve or more prominent ribs, which are rendered rugose by having small spines, which evidently projected sharply forward, now broken away. Two or more smaller ribs sculpture the very wide interspaces. Incremental sculpture prominent. The hinge line is very short and the ears are very subdued and not prominent. The areas adjacent to the ears under the umbones in the combined valves are deeply depressed. Length, 85 mm.; breadth, 59 mm.; thickness of the combined valves, 60 mm.; the left valve projects as much as 20 mm. over the right valve in some individuals.

Holotype: L.S.J.U. type collection, type number 438, from S.D.S.N.H. and L.S.J.U. locality 437. Collected from the head of Wiley Canyon, Piru quadrangle, Ventura County, California. *Paratype*: L.S.J.U. type collection, type number 423. J. S. McKenna and L. Wm. Wiedey, collectors; Vaqueros formation, lower Miocene.

This new species of *Spondylus* is in some respects resembled by *S. gaederopus* Linné,⁷⁹ the type of the genus. It may be separated from that living species in being more elongate, with higher umbones, and possessing the depressed areas adjacent to the ears.

Named in honor of Dr. James Perrin Smith in appreciation of his very highly valued assistance and encouragement.

***Spondylus inezana* Wiedey, sp. nov.**

Plate 16, figures 2, 3

Shell very large, of variable shape, generally subcircular, inequivalve to a large degree, inequilateral, and slightly to moderately

⁷⁹ *Conchologia Iconica*, Vol. 9, pl. 3, sp. 13, 1856.

inflated in most individuals. Anterior dorsal margin often long and nearly straight to broadly rounded, more sharply curved at its extremity. Basal margin broadly rounded to the posterior dorsal extremity, which is a little more sharply rounded. The posterior dorsal margin is quite broadly curved but may be straight and long. Umbones of subequal size, with the left valve possessing the more prominent umbo, which is generally moderately elevated and projected slightly over the umbo of the right valve. Beaks in most forms obscured, but apparently distant, situated in the anterior portion of the shell and not prominent. The left valve is the more strongly convex with occasional individuals possessing a nearly flat right valve. Valves sculptured by about fifteen prominent radiating ridges, which are narrow and appear to have supported numerous small spines, projecting obliquely forward. The ribs are more prominent on the central parts of the valves and less distinct toward the dorsal margins. Between the heavier ribs is another system of ribbing in the wide interspaces, consisting of a rather fine median rib flanked by a varying number of finer thread-like riblets, generally four or more. Concentric wavy lines of growth become very prominent on the older parts of the shell and assume the character of wavy folds in some of the old individuals. Hinge line not long; ears vary in size, projecting moderately on either side of the beaks. Length, 72 mm.; breadth, 60 mm.; thickness of the combined valves, 45 mm.

Holotype: S.D.S.N.H. type collection, type number 29, from S.D.S.N.H. and L.S.J.U. locality 437. This form was collected from the head of Wiley Canyon, Piru quadrangle, Ventura County, California. *Paratype*: L.S.J.U. type collection, type number 424. J. S. McKenna and L. Wm. Wiedey, collectors; Vaqueros formation, lower Miocene.

This new species of *Spondylus* is somewhat resembled by a living species of the genus from the West Coast, *S. crassisquama* Lamarck,⁸⁰ found living in the waters of Lower California. The fossil form may be distinguished from the latter by the absence of the broad spatulate spines, the more prominent ribbing, the less regular shape, and the less distinctive sculpture.

From *S. perrini* Wiedey. This new species differs in being much less convexly inflated and in possessing a much more circular outline.

⁸⁰ Conchologia Iconica, Vol. 9, pl. 6, sp. 24, 1856.

Order **ANOMALODESMACEA** DallSuperfamily **Anatinacea** Dall

SECTION EUSIPHONIA

Family **PHOLADOMYACIDAE** GrayGenus **PHOLADOMYA** SowerbyTYPE: **P. candida** Sowerby**Pholadomya kernensis** Wiedey, sp. nov.

Plate 17, figures 1, 2

Shell of medium size, ovate, very inequilateral, equivalve, well inflated; anterior dorsal margin short and gently rounded, dropping nearly vertically from the beaks; anterior extremity bluntly rounded. Basal margin long, parallel with the posterior dorsal margin and gently convex. The posterior extremity is rounded, a little more sharply above than below, and is moderately gaping. The posterior dorsal margin is long, nearly straight, and approximately horizontal. Umbones prominent, broad, elevated, with the umbonal ridge distinct. Beaks small, situated at the anterior end of the shell, pointed, incurved, and very close-set. The sculpture consists of about fifteen narrow, radiating ribs, more prominent on the umbones, sculpturing the major portion of that part of the shell. A very small anterior and a very large posterior part of the shell is unmarked by the ribbing. Surface covered by prominent, coarse, concentric waves which reach a fuller development over the posterior and ventral areas. The concentric sculpture is obscured by the radiating system of ribs on the umbones. The anterior dorsal margins and posterior ventral margins are tightly closed while the posterior dorsal margins are gaping. Length, 55 mm.; breadth, 30 mm.; thickness of both valves, 30 mm.

Holotype: L.S.J.U. type collection, type number 437, from S.D.S.N.H. and L.S.J.U. locality 438. SW $\frac{1}{4}$ of SE $\frac{1}{4}$ of Section 12, T. 27 S., R. 28 E., north of Poso Creek, Kern County, California. B. F. Hake and Wm. Kleinpell, collectors; Temblor formation, middle Miocene.

This species of *Pholadomya* is apparently the only Cenozoic form known to exist in the Tertiary of the West Coast since the occur-

rence of *Pholadomya nasuta* Gabb⁸¹ in the Martinez Eocene strata of California. It may readily be distinguished from the latter species by its more quadrate form, less sharply pointed beaks, and straighter basal margin. The only known living member of the genus is the rare form, *P. candida* Sowerby,⁸² which it resembles in some respects, but from which it is easily separable by the more quadrilateral shape, more flattened, broader, and less prominently elevated umbones of the latter.

There has been some question raised as to the possibility of this form being an individual derived from another formation, but the fragile character of the shell, coupled with its remarkably excellent preservation in a matrix of the formation in which it was found, together with some of the characteristic fossils of the Temblor beds of that section, preclude such a possibility.

Order **TELEODESMACEA** Dall

SECTION CYCLODONTA

Superfamily **Cardiacea** Lamarck

Family **CARDIIDAE** Fischer

Genus **CARDIUM** Linné

TYPE: **C. costatura** Linné

Cardium arcumbona Wiedey, sp. nov.

Plate 17, figure 5

Shell of moderate size, subquadrate in outline, slightly inequilateral, and only gently convex. Anterior dorsal margin is concavely rounded under the beak and convexly rounded toward the extremity, with the anterior dorsal area separated from the main body of the shell by a distinct shoulder from the beak to the extremity. This area is nearly straight and is well flattened. Anterior extremity quite sharply rounded, with the base broadly convex; posterior dorsal extremity apparently moderately rounded; posterior dorsal margin not long and sloping quite straight from the beak. Umbo not large, but

⁸¹ Geology of California, Paleontology, Vol. 2, p. 152, pl. 30, fig. 124, 1864.

⁸² SOWERBY, Genera of Fossil Shells, fascicle 19, 1823.

prominent, elevated, incurved, with a tendency to be angular. Beak small, slightly anterior, sharp, gently elevated, and distinctly prosogyrous. The sculpture consists of about twenty broadly rounded ribs, wider than the interspaces. Length, about 35 mm.; breadth, 32 mm.; thickness of a single valve, about 14 mm.

Holotype: Left valve; S.D.S.N.H. type collection, type number 31, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east slope of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This new species differs from other known forms of the West Coast fossil *Cardium*s in the possession of the distinctive flattening of the anterior dorsal area, anterior to the prominent shoulder in that part of the valve. It is somewhat resembled by *C. biangulatum* Sow-erby,⁸³ but has a sharper umbo and wider spacing of the ribs.

Collected at the same locality with this species were: *Agasoma barkerianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongena californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione panzana* Anderson and Martin, *C. temblorensis* F. M. Anderson, *Clementia pertenuis* Gabb, *Cytherea dumblei* F. M. Anderson, *Dosinia mathewsonii* Gabb, *Pecten andersoni* Arnold.

***Cardium schencki* Wiedey, sp. nov.**

Plate 17, figures 3, 4

Cardium vaquerosensis Arnold, Arnold, U.S. Geological Survey Bulletin No. 396, p. 57, pl. 9, fig. 2, 1909. Not *C. vaquerosensis* Arnold, Proceedings of the U.S. National Museum, Vol. 34, p. 378, pl. 34, fig. 3, 1908.

Shell moderately large, subcircular in outline, slightly inequilateral, and gently to quite convex. The anterior dorsal margin is not long, but is straight and broadly rounded at the extremity. The basal margin is very broadly rounded to the posterior dorsal extremity, which is subtruncate. Posterior dorsal margin quite long, slightly concave or straight in outline, with a slight concavity from the umbo to the outer margin of the posterior dorsal area, running from under the beaks to the extremity of the shell. Umbones moderately large, prominent, elevated, with the beaks small, sharply pointed, strongly incurved, and perceptibly prosogyrous. The sculpture consists of thirty prominent ribs of flatly rounded cross section, with narrower

⁸³ *Conchologia Iconica*, Vol. 2, pl. 6, sp. 29, 1844.

interspaces. Incremental sculpture obscured. The breadth of the shell is slightly less than the length.

Holotype: Catalogue No. 165598, U.S. National Museum, from the east flank of a high hill northeast of Oil City, in SE $\frac{1}{4}$ of NE $\frac{1}{4}$ of Section 16, T. 19 S., R. 15 E. *Paratype*: S.D.S.N.H. type collection, paratype number 32, from S.D.S.N.H. and L.S.J.U. locality 425. Collected in the short canyon trending west from the head of Dry Canyon, at the base of the east-west ridge forming the divide, two miles south of Calabasas, Santa Monica Mountains, Los Angeles County, California. Paratype number 431, L.S.J.U. type collection. L. Wm. Wiedey, collector; Temblor formation; middle Miocene.

It appears as if Arnold, in his paper on the paleontology of the Coalinga district, had confused this new species with the species which he at an earlier date described from the Vaqueros of the Santa Cruz Mountains. He erroneously declared that this new form, which he figured, had four more ribs than the type of the species which has thirty-four. Yet this form apparently has no more than thirty-three ribs. Comparison of descriptions, figures, and material indicates that the two forms here discussed cannot be conspecific. So it becomes necessary to propose a name for the new species.

C. vaquerosensis Arnold can be readily distinguished from this new form by the more cordate appearance of the shell, sharper and more prominently elevated umbones, which extend considerably above the hinge line, and in the smaller number of ribs of the Vaqueros species.

Found associated with this species were: *Bulla anglonana* F. M. Anderson, *Cancellaria condoni* Cooper, *Murex topangensis* Arnold, *Calyptrea radians* Linné, *Turritella ocoyana* Conrad, *Turritella temblorensis* Wiedey, sp. nov., *Clementia pertenuis* Gabb, *Dosinia matthewsonii* Gabb.

Named for Dr. H. G. Schenck in recognition of his valued interest and aid during the preparation of this manuscript.

SECTION TELEODONTA

Superfamily **Veneracea** Menke

Family VENERIDAE Leach

Genus **DOSINIA** ScopoliTYPE: *D. disca* Reeve***Dosinia margaritana*** Wiedey, sp. nov.

Plate 18, figures 1, 2, 3

Shell moderately large, subcircular in outline, equivalve, but quite inequilateral; heavy and thick-set. Anterior dorsal margin short, straight to slightly concave, with anterior dorsal extremity rather sharply rounded; basal margin quite regularly and broadly rounded. The posterior dorsal extremity is slightly more sharply rounded than is the base, while posterior dorsal margin presents only a gently convex slope, which is long. Umbones large and broadly inflated; beaks small, inturned, and strongly prosogyrous, but not prominent. The sculpture consists of fine, rounded, narrow, concentric lines which are closely spaced on the umbones, but which become more widely separated toward the basal margin or are transformed into thread-like lines in that part of the disk. Lunule of moderate size, distinctly depressed, cordate in outline, defined by a narrow impressed suture. Length, 62 mm.; breadth, 58 mm.; thickness of both valves, 33 mm.

Holotype: S.D.S.N.H. type collection, type number 33, from S.D.S.N.H. and L.S.J.U. locality 436. This form was collected about 0.4 of a mile east of La Panza on the south side of the low ridge forming the north wall of the shallow canyon through which the road from McKittrick to La Panza passes. *Paratype*: L.S.J.U. type collection, type number 425. M. E. Lake and L. Wm. Wiedey, collectors; Vaqueros formation, lower Miocene.

This new form has more prominent umbones and more elevated beaks than *D. merriami* Clark,⁸⁴ which in some respects is of similar outline. The varietal form *D. merriami occidentalis* Clark⁸⁵ has less rotund shape and more anteriorly curved umbones than are found

⁸⁴ University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 22, p. 460, pl. 49, figs. 1, 2; pl. 52, figs. 1, 2, 19.

⁸⁵ *Op. cit.*, p. 462, pl. 50, fig. 1.

in the new species. The form with which the species here described might be most easily confused is *D. mathewsonii* Gabb.⁸⁶ But the latter is of only half the thickness and exhibits an extension of the posterior extremity not found in any of the specimens examined of this new species. Material from the type locality of Gabb's species closely conforms to the figure given by him.

Found associated with this new species were: *Crepidula princeps* Conrad, *Arca osmonti* Dall, *Clementia pertenuis* Gabb, *Panope generosa* Gould, *Pecten bowersi* Arnold, *P. ferrini* Arnold, *Phacoides acutilineatus* Conrad, *Spisula albaria* Conrad.

Genus **CLEMENTIA** Gray

TYPE: **Venus papyracea** Gray

Clementia inequalis Wiedey, sp. nov.

Plate 18, figures 4, 5

Shell of moderate size, subquadriangular in outline, equivalve but very inequilateral, quite inflated and thin shelled. Anterior dorsal margin short and gently convex, dropping nearly vertically from the beaks; anterior dorsal margin broadly rounded while the basal margin exhibits a smaller degree of curvature. The posterior dorsal extremity is more sharply rounded, about the same degree above as below. Posterior dorsal margin long, gently convexly curving, sloping gradually away from the beaks. The umbones are at the anterior end of the shell, prominent, inflated, broadly convex, and gently incurved. Beaks small, incurved, prosogyrous, and slightly elevated. The sculpture consists of concentric waves of rounded cross section which are more prominent on the umbones. Toward the margin of the disk the concentric sculpture tends to be reduced to fine concentric lines which are quite closely spaced. Occasionally fine thread-like lines sculpture the waves. Lunule small and only slightly sunken below the beaks. It is well defined and of cordate outline. Length, 45 mm.; breadth, 38 mm.; thickness of the combined valves, 23 mm.

Holotype: S.D.S.N.H. type collection, type number 34, collected from S.D.S.N.H. and L.S.J.U. locality 406. This form was secured from the west end of South Mountain in outcropping beds along the Santa Clara River, a few feet above the river bed on its east bank,

⁸⁶ Geology of California, Paleontology, Vol. 2, p. 57, pl. 15, fig. 16, 1869.

two miles southwest of Santa Paula, Ventura County, California. *Paratype*: L.S.J.U. type collection, type number 426. L. Wm. Wiedey, collector; Vaqueros formation, lower Miocene.

This new species can be confused with but few known species of the genus *Clementia*. It resembles in external outline most closely *C. (Clementia) dariena dariena* Conrad⁸⁷ of the middle Miocene of Colombia, but has straighter posterior ventral and dorsal margins with a much more broadly rounded dorsal extremity than the South American species. It differs from the common Tertiary form from California, *C. (Egesta) pertenuis* Gabb,⁸⁸ in being much more inequilateral, in having a much shorter anterior dorsal margin, smaller anterior dorsal area, and beaks less markedly separated from the main body of the shell.

Found occurring with this species were: *Rapana imperialis* Hertlein and Jordan, *R. vaquerosensis* Arnold, *Turritella inczana* Conrad, *Cardium vaquerosensis* Arnold, *Dosinia matheysonii* Gabb, *Panope generosa* Gould, *Pecten sespeensis hydei* Arnold.

***Clementia* (?) *elongata* Wiedey, sp. nov.**

Plate 18, figure 6

Shell of moderately large size, thin, ovoid in outline, distinctly inequilateral, and only gently inflated. Anterior dorsal margin short and sloping concavely away from the beak to the extremity, which is sharply rounded above, less so below. The basal margin is very gently convexly rounded to the posterior dorsal extremity, which is broadly rounded. The posterior dorsal margin is nearly straight and slopes gradually away from the beak. Umbo not large, but prominent, convexly rounded, and slightly elevated. Beak small, sharp, elevated, and strongly prosogyrous. The sculpture consists of concentric waves, which are regularly rounded and separated by interspaces of about the same width, similarly rounded. Toward the basal margin the sculpture is much weaker than on the umbo. Lunule apparently shallow and not large. Length, 56 mm.; breadth, 42 mm.; thickness of a single valve, 12 mm.

Holotype: Left valve; S.D.S.N.H. type collection, type number 35, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east

⁸⁷ U.S. Geological Survey, Professional Paper No. 147, part C, p. 34, pl. 14, figs. 6, 7, 8, 9, 10, 11, 1926.

⁸⁸ *Op. cit.*, p. 40, pl. 16, figs. 1, 2, 3, 4, 5, 6.

slope of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. Merrill E. Lake, collector; Temblor formation, middle Miocene.

This rather distinctive form, which bears a closer resemblance to the genus *Clementia* than to any other genus to which it might be assigned, because of its shape, thin shell, and characteristic sculpture, differs from other known species of *Clementia* in being very extended anteriorly and posteriorly, in having a moderately long straight ventral margin, and in having the beak greatly elevated, sharp, and separated from the main body of the shell. It is here tentatively assigned to this genus because of the similarities noted above.

Found associated were: *Agasoma barkerianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongena californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione panzana* Anderson and Martin, *C. temblorensis* F. M. Anderson, *Clementia pertenuis* Gabb, *Cytherea dumblei* F. M. Anderson, *Dosinia mathesonii* Gabb, *Pecten andersoni* Arnold.

Superfamily **Tellinacea** Blainville

Family TELLINIDAE Deshayes

Genus **TELLINA** (Linné) Lamarck

TYPE: *T. virgata* Linné

Tellina oldroydi Wiedey, sp. nov.

Plate 19, figure 3

Shell of large size, elongate, and subovate in outline, slightly inequivalve, perceptibly inequilateral, gently inflated, and thin shelled. Anterior dorsal margin long, nearly straight, or slightly convex; anterior dorsal extremity quite sharply rounded, with the basal margin regularly but very broadly rounded. The posterior dorsal extremity is subtruncate, with the margin sloping straight from the beaks at an angle similar to that taken by the anterior dorsal margin. Posterior end gaping and twisted to the right. Umbones not large and only gently elevated. The beaks are situated in the posterior portion of the shell, inturped, and pointed posteriorly. The shell is smooth but for the concentric, incremental lines of growth. The posterior portion of the right valve shows a depressed area separated from the

main body of the shell by a distinct shoulder, which passes from the beaks to the posterior extremity. On the left valve in the position of the shoulder on the opposite valve, a faint sulcus is developed. Length, 68 mm.; breadth, 48 mm.; thickness of both valves, 20 mm.

Holotype: S.D.S.N.H type collection, type number 36, from S.D.S.N.H. and L.S.J.U. locality 425. Collected from the canyon trending west from the head of Dry Canyon, at the base of the east-west ridge forming the divide, two miles south of Calabasas, Santa Monica Mountains, Los Angeles County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

The form, *T. nevadensis* Anderson and Martin,⁸⁹ of the Temblor, while similar to this new species, is more elongate anteriorly, less elongate posteriorly, and has a more sharply rounded anterior extremity. Among the living forms it is resembled by *T. lutca* Gray,⁹⁰ living in Alaska, but possesses a straighter ventral margin, a less elongate posterior extremity, and a greater thickness than that living form.

Found occurring with this species were: *Bulla cantuaënsis* Anderson and Martin, *Cancellaria condoni* Cooper, *Murex topangensis* Arnold, *Calyptrea radians* Linné, *Turritella ocoyana* Conrad, *T. temblorensis* Wiedey, sp. nov., *Clementia pertenuis* Gabb, *Dosinia mathezonii* Gabb.

Named for Mrs. I. S. Oldroyd, whose assistance in comparison of the recent shells has aided frequently in the study of the fossil forms.

Genus **MACOMA** Leach, 1819

TYPE: **M. tenera** Leach

Macoma copelandi Wiedey, sp. nov.

Plate 19, figure 2

Shell of small size, subovate in outline, distinctly inequivalve, very inequilateral, and quite inflated. Anterior dorsal margin long, sloping at a very low angle from the beaks and gently convex in contour. The anterior dorsal extremity is regularly but more sharply rounded.

⁸⁹ Proceedings of the California Academy of Sciences, 4th ser., Vol. 4, No. 3, p. 61, pl. 2, figs. 3a, 3b, 3c, 1914.

⁹⁰ Conchologia Inconica, Vol. 17, pl. 19, sp. 97a, 97b, 1870.

The basal margin is gently rounded. Posterior dorsal extremity sharply truncated and twisted with the posterior dorsal margin nearly straight, but sloping away quite sharply from the beaks. Umbones elevated, prominent, and sharp, more markedly on the right than on the left valve; beaks prominent, elevated slightly, adjacent, inturned, and sharp. A faint fold passes from the beak on the right valve to the posterior dorsal extremity, in front of which there is a distinct depression. The posterior end of the shell is turned to the right and is more apparent on the right than on the left valve, since the left valve is broadly convex and shows no folding. Strong concentric incremental lines of growth are the only visible sculpture. Length, 30 mm.; breadth, 20 mm.; thickness of the attached valves, 10 mm.

Holotype: S.D.S.N.H. type collection, type number 37, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east slope of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This new species of *Macoma* is differentiated from its resemblant form, *M. indentata* Carpenter, var. *tenuirostris* Dall,⁹¹ in being longer, more inflated anteriorly, and in lacking the prominent shoulder found in the posterior portion of the varietal form. It is resembled in some respects by *M. andersoni* Clark,⁹² but is more elongate and much more inequilateral.

Found associated with this new species were: *Agasoma barkerianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongena californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione panzana* Anderson and Martin, *C. temblorensis* F. M. Anderson, *Clementia pertenuis* Gabb, *Cytherca dumblei* F. M. Anderson, *Dosinia mathewsonii* Gabb, *Pecten andersoni* Arnold.

Named for Mr. G. Copeland Williams in recognition of his valued interest in this work.

***Macoma panzana* Wiedey, sp. nov.**

Plate 19, figure 1

Shell of this species large, of subcircular outline, slightly inequilateral, thin shelled, and well inflated. Anterior dorsal margin gently

⁹¹ Proceedings of the U.S. National Museum, Vol. 23, p. 309, 1901.

⁹² University of California Publications, Bulletin of the Department of Geology, Vol. 8, No. 22, p. 473, pl. 61, fig. 12, 1915.

convexly rounded, sloping quite sharply downward from the beak to the extremity, where it is very broadly rounded. The basal margin is broadly convex to the posterior dorsal extremity, which is truncated. The posterior dorsal margin slopes nearly straight down from the beak to the extremity. Umbo rather large, inflated, prominently rounded, and broad; beak small, slightly elevated, inconspicuous, and situated slightly posterior to the middle of the valve. A moderately sharp fold, in front of which, on the main body of the shell, there is a slightly depressed area, extends from the beak to the posterior dorsal extremity. Concentric incremental lines of growth form the only sculpturing. Length, 60 mm.; breadth, 53 mm.; thickness of the single valve, 11 mm.

Holotype: S.D.S.N.H. type collection, type number 38, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east slope of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. L. Wm. Wiedey, collector; Temblor formation, middle Miocene.

This unusually broadly rounded species of *Macoma* is approached most clearly in the similarity by *M. secta* Conrad, var. *edulis* Nuttall, a living form from the California coast, but lacks the prominent fold on the posterior portion with the flaring area posterior to it. This new species is more broadly rounded in outline than *M. secta* Conrad⁹³ and lacks the large area posterior to the beaks found in that species.

Superfamily **Mactracea** Gray

Family MACTRIDAE Gray

Genus **SPISULA** Gray

TYPE: *Mactra solida* (Linné) Gray, 1847

Spisula abbotti Wiedey, sp. nov.

Plate 19, figures 4, 5

Shell moderate in size, subtriangular in outline, equivalve, inequilateral, thick-set, well inflated, and possesses a heavy shell. The an-

⁹³ U.S. Geological Survey Bulletin No. 396, p. 146, pl. 20, fig. 1, 1909.

terior dorsal margin is long, gently concave, and slopes sharply away from the beaks to the anterior dorsal extremity, which is quite abruptly rounded. Basal margin regularly slightly rounded; posterior dorsal margin moderately long and sloping quickly away from the beaks, being slightly concave in contour. The posterior dorsal extremity is less sharply rounded than is the corresponding anterior portion. Umbones very large, prominent, inflated, incurved, exhibiting no distinct umbonal ridge. Beaks moderately large, situated in the anterior portion of the shell, elevated, and slightly prosogyrous. The posterior portion of the shell is the more inflated and the point of greatest thickness falls well up on the valves, just posterior to the beaks. In the attached valves the posterior dorsal areas form together a flattened area which is broad and bounded by sharply rounded, though not angular, shoulders in that portion of the shell. Length, 58 mm.; breadth, 42 mm.; thickness of the attached valve, 31 mm.

Holotype: S.D.S.N.H. type collection, type number 39, from S.D.S.N.H. and L.S.J.U. locality 440. Collected two miles northwest of the power house at the mouth of Kern Canyon, Kern County, California. W. C. Mendenhall, collector; Temblor formation, middle Miocene.

This species of *Spisula* is resembled by the common fossil species, *S. albaria* Conrad,⁹⁴ but has a much sharper anterior dorsal extremity, longer, more gently sloping anterior dorsal margin, with sharper umbones than the latter form. Among the living forms it is most closely approximated by *S. planulata* Conrad,⁹⁵ but it is thicker, higher, more equilateral and with a sharper anterior dorsal extremity than the living species.

This new species is named in honor of Mr. C. G. Abbott, whose great interest in natural history is recognized.

Spisula granti Wiedey, sp. nov.

Plate 20, figures 2, 3

Shell thick and of large size and subtrigonal in outline; equivalve, equilateral, well inflated. Anterior dorsal margin of moderate length,

⁹⁴ U.S. Geological Survey, Professional Paper 59, append. 1, p. 150, fig. 4, 1909.

⁹⁵ Journal of the Academy of Natural Sciences, Philadelphia, Vol. 7, p. 240, 1837.

sloping away from the beaks rather sharply, either straight or gently concave in contour. The anterior dorsal extremity is more sharply rounded above than below. The basal margin is regularly and broadly rounded to the posterior dorsal extremity, which is rather more sharply rounded. Posterior dorsal margin nearly straight, sloping at an angle similar to that assumed by the corresponding anterior feature. Umbones prominent, sharply convexly inflated and elevated without a distinct umbonal ridge; beaks large, blunt, strongly in-turned, adjacent, and situated equidistantly from either extremity of the shell. The sculpture consists of concentric incremental lines which are fine and close-set. Lunule obscured but apparently not deep, but cordate in outline and of moderate size. The ligament is in a shallow excavated groove which is about half the length of the posterior dorsal margin. Two poorly defined ridges outline the posterior area of the shell and extend to the posterior extremity, but do not markedly separate this area from the main body of the shell. Length, 68 mm.; breadth, 57 mm.; thickness of attached valves, 35 mm.

Holotype: S.D.S.N.H. type collection, type number 40, from S.D.S.N.H. and L.S.J.U. locality 200. Collected from the SE $\frac{1}{4}$ of Section 9, T. 20 S., R. 6 E., in the Junipero Serra quadrangle on the east side of Vaqueros Creek, Monterey County, California. L. Wm. Wiedey, collector; Vaqueros formation, lower Miocene.

This new species of *Spisula* is resembled by *S. albaria* Conrad,⁹⁶ but lacks the truncation of the posterior extremity and the very sharp rounding of the anterior extremity of that species. It apparently is thinner than Conrad's type. This new fossil form is in some respects resembled by *S. falcata* Gould,⁹⁷ now living in the Gulf of California, from which it differs in its greater thickness, greater proportionate height, and more prominent umbones.

Found occurring with this species were: *Rapana vaquerosensis* Arnold, *Turritella inczana* Conrad, *Cardium vaquerosensis* Arnold, *Chione* sp. (large, sp. undet.), *Dosinia matthewsonii* Gabb.

This new species is named in recognition of the great aid and encouragement given the writer by Mr. U. S. Grant IV.

⁹⁶ U.S. Geological Survey, Professional Paper 59, append. 1, p. 150, fig. 4, 1909

⁹⁷ Stanford University Publications, University Series, Geological Sciences, Vol. 1, No. 1, p. 195, pl. 20, figs. 1, 2, 3, 1924.

SECTION ASTHENODONTA

Superfamily **Myacea** Menke

Family SAXICAVIDAE Gray

Genus **PANOPE** Menard, 1807TYPE: **Mya glycimeris** Born**Panope tenuis** Wiedey, sp. nov.

Plate 20, figure 4

Shell large, elongate-ovate in outline, apparently equivalve, very inequilateral, and of thinly cordate cross section. Anterior dorsal margin short and sloping gently from the beaks, slightly convex in contour; anterior dorsal extremity broadly and evenly rounded with the basal margin very long and nearly straight. Posterior extremity widely gaping and broadly rounded below; posterior dorsal margin long and very slightly concave. Umbones not large but slightly elevated and strongly inturned. Beaks small, adjacent, situated in the anterior portion of the shell, slightly prosogyrous, and not prominent. The sculpture consists of concentric waves of rounded cross section, finer on the umbones than on the outer margins of the shell, where they have a tendency to become but irregularly spaced ridges. Fine thread-like incremental lines of growth mark the shell concentrically, more prominently on the dorsal areas. Shell quite thin. The greatest convexity of the form occurs just posterior to the beaks, less than midway between the ventral and dorsal margins, closer to the latter. Length, 128 mm.; breadth, 60 mm.; thickness of the attached valves, about 50 mm.

Holotype: S.D.S.N.H. type collection, type number 41, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from the east side of the first ridge west of Syncline Hill, two miles west of Simmler, San Luis Obispo County, California. M. E. Lake, collector; Temblor formation, middle Miocene.

This new species of *Panope* is somewhat resembled by the common living form, *P. generosa* Gould,⁹⁸ which ranges back to the Oligocene, but lacks the great breadth of shell found in that living species. The very inequilateral form of this new species is a dis-

⁹⁸ U.S. Geological Survey Bulletin No. 396, p. 142, pl. 18, fig. 4, 1909.

tinctive characteristic and serves as a means of separating it from *P. ramonensis* Clark,⁹⁹ a fossil species from the San Lorenzo formation of Oligocene age. This new form is to be distinguished from *P. estrellanus* Conrad¹⁰⁰ by the latter's more equilateral shape with greater breadth compared to its length. While the type has been slightly crushed, its form has not been distorted and its original character not obscured.

Found occurring with this new species were: *Agasoma barkearianum* Cooper, *Antiplanes piercei* Arnold, *Crepidula princeps* Conrad, *Melongena californica* Anderson and Martin, *Turritella ocoyana* Conrad, *Chione panzana* Anderson and Martin, *C. temblorensis* F. M. Anderson, *Clementia pertenuis* Gabb, *Cythera dumblei* F. M. Anderson, *Dosinia matthewsonii* Gabb, *Pecten andersoni* Arnold.

Subkingdom VERMES

CLASS ANNELIDA

Order POLYCHAETA

Suborder TUBICOLA

Genus SERPULA Linné

Serpula careyi Wiedey, sp. nov.

Plate 20, figure 1

Individuals of this new species of worm tubes are generally between two and three millimeters in diameter and attain lengths of over eighty millimeters. The tests are probably not sculptured but are rough to a slight degree on the surface and are thin. They are not straight but curve slightly, in rare cases they may curve sharply. They are often matted closely together in the rock and have their interiors filled with some foreign material.

Holotype: S.D.S.N.H. type collection, type number 42, collected from S.D.S.N.H. and L.S.J.U. locality 439. This form was collected from a piece of float at the confluence of Cantinas Creek with the

⁹⁹ University of California Publications, Bulletin of the Department of Geological Sciences, Vol. 13, No. 4, p. 106, pl. 10, figs. 2, 3, 1924.

¹⁰⁰ Pacific Railroad Reports, Vol. 7, p. 194, pl. 7, fig. 5, 1857.

Nacimiento River, San Luis Obispo County, California. L. Wm. Wiedey, collector; Vaqueros formation, lower Miocene.

These featureless forms of low order of animal life are apparently not agglutinated forms, as those described by Dall¹⁰¹ from the Astoria beds of Oregon, of Miocene age. Nor are they as large and massive or compact as those described by Dall. Because of the indistinctive character of this type of fossil, it is extremely difficult to be certain of its systematic position. It is, however, assigned here tentatively in the manner considered most expedient.

¹⁰¹ U.S. Geological Survey, Professional Paper No. 59, p. 138, pl. 20, figs. 1, 2, 1909.

EXPLANATION OF PLATES

PLATE 9

FIGURE	PAGE
1. <i>Architectonica compressa</i> Wiedey, sp. nov.	109
× 1½. Holotype No. 12, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 428. Collected two miles southeast of El Modena, Orange County, California. Temblor formation, middle Miocene.	
2. <i>Architectonica compressa</i> Wiedey, sp. nov.	109
× 1½. Umbilical view of figure 1.	
3. <i>Conus juanensis</i> Wiedey, sp. nov.	123
Natural size. Holotype No. 16, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 432. Collected from eastern San Luis Obispo County, California. Temblor formation, middle Miocene.	
4. <i>Rapana serrai</i> Wiedey, sp. nov.	116
Natural size. Holotype No. 13, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 442. Collected in the Nacimiento River region of San Luis Obispo County, California. Vaqueros formation, lower Miocene.	
5. <i>Rapana serrai</i> Wiedey, sp. nov.	116
Natural size. Apertural view of figure 4.	
6. <i>Rapana serrai</i> Wiedey, sp. nov.	116
Natural size. Back view of figure 4.	

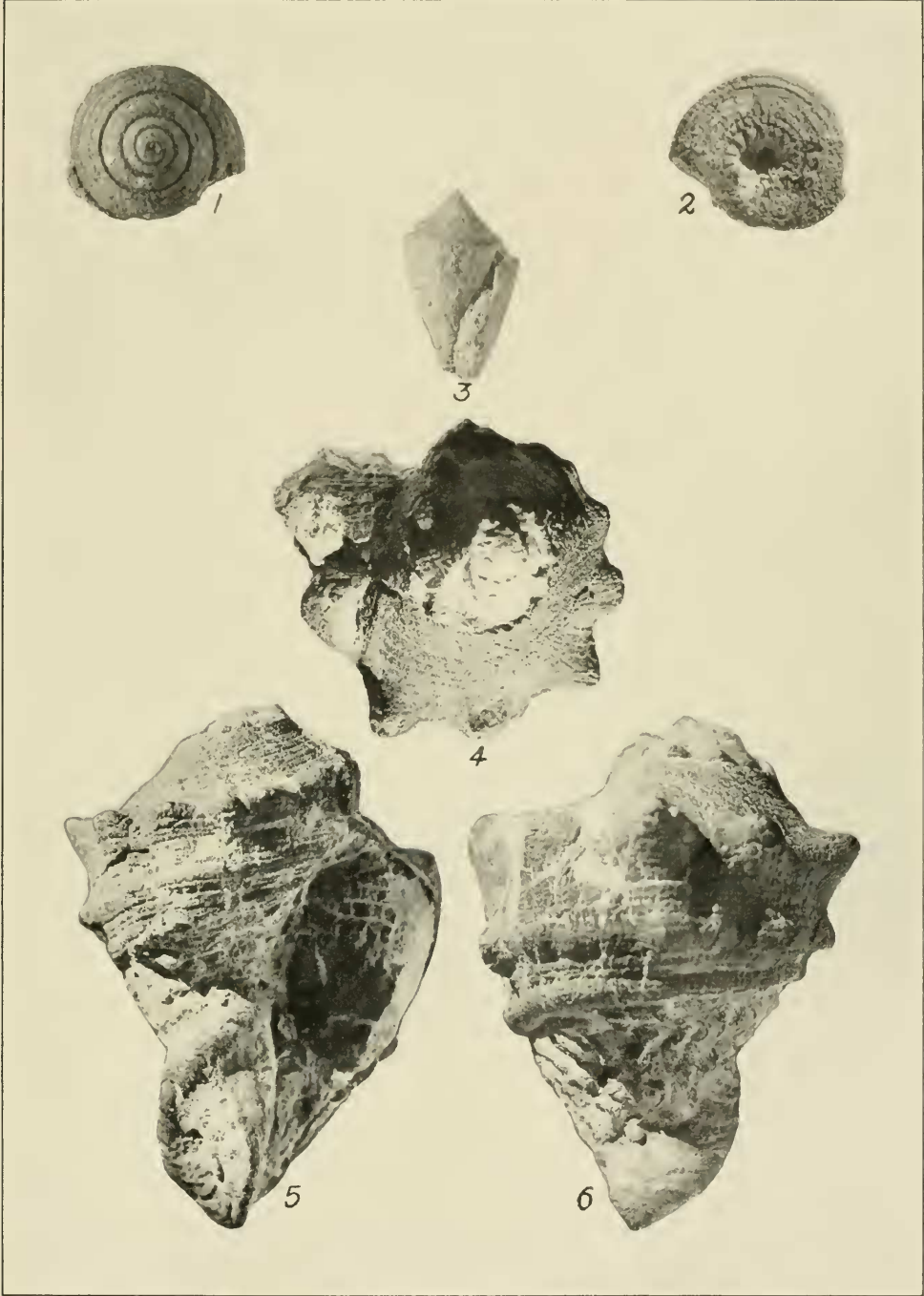


PLATE 10

FIGURE	PAGE
1. <i>Turritella ocoyana</i> Conrad	120
Natural size. Plesiotype No. 47, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 432. Collected in eastern San Luis Obispo County, California. Temblor formation, middle Miocene.	
2. <i>Turritella ocoyana</i> Conrad	120
Natural size reproduction of one of the type figures of the species given by Conrad.	
3. <i>Turritella ocoyana</i> Conrad	120
Natural size. Plesiotype No. 43, S.D.S.N.H. type collection, from the same locality as figure 1.	
4. <i>Turritella ocoyana</i> Conrad	120
Natural size reproduction of another of the type figures of the species given by Conrad.	
5. <i>Turritella ocoyana</i> Conrad	120
Natural size reproduction of what is probably the reverse of figure 4, given by Conrad along with figures 2 and 4.	
6. <i>Turritella ocoyana</i> Conrad	120
Natural size. Rephotograph of the holotype of <i>T. wittichi</i> Hertlein and Jordan. This form is considered intermediate between <i>T. bösei</i> Hertlein and Jordan and <i>T. ocoyana</i> Conrad, but more closely allied to the latter.	
7. <i>Turritella bösei</i> Hertlein and Jordan	117
Natural size. Plesiotype No. 44, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 442. Collected at Barker's Ranch, Kern County, California. Temblor formation, middle Miocene. This form is intermediate between <i>T. ocoyana</i> Conrad and <i>T. bösei</i> Hertlein and Jordan, but more closely allied to the latter.	
8. <i>Turritella ocoyana</i> Conrad	120
Natural size. Collected in Lower California. Figured to show some of the characteristics of <i>T. bösei</i> Hertlein and Jordan and <i>T. ocoyana</i> Conrad in the same individual. It is apparently closer to the latter species.	
9. <i>Turritella ocoyana</i> Conrad	120
Natural size reproduction of one of the type figures of the species given by Conrad.	

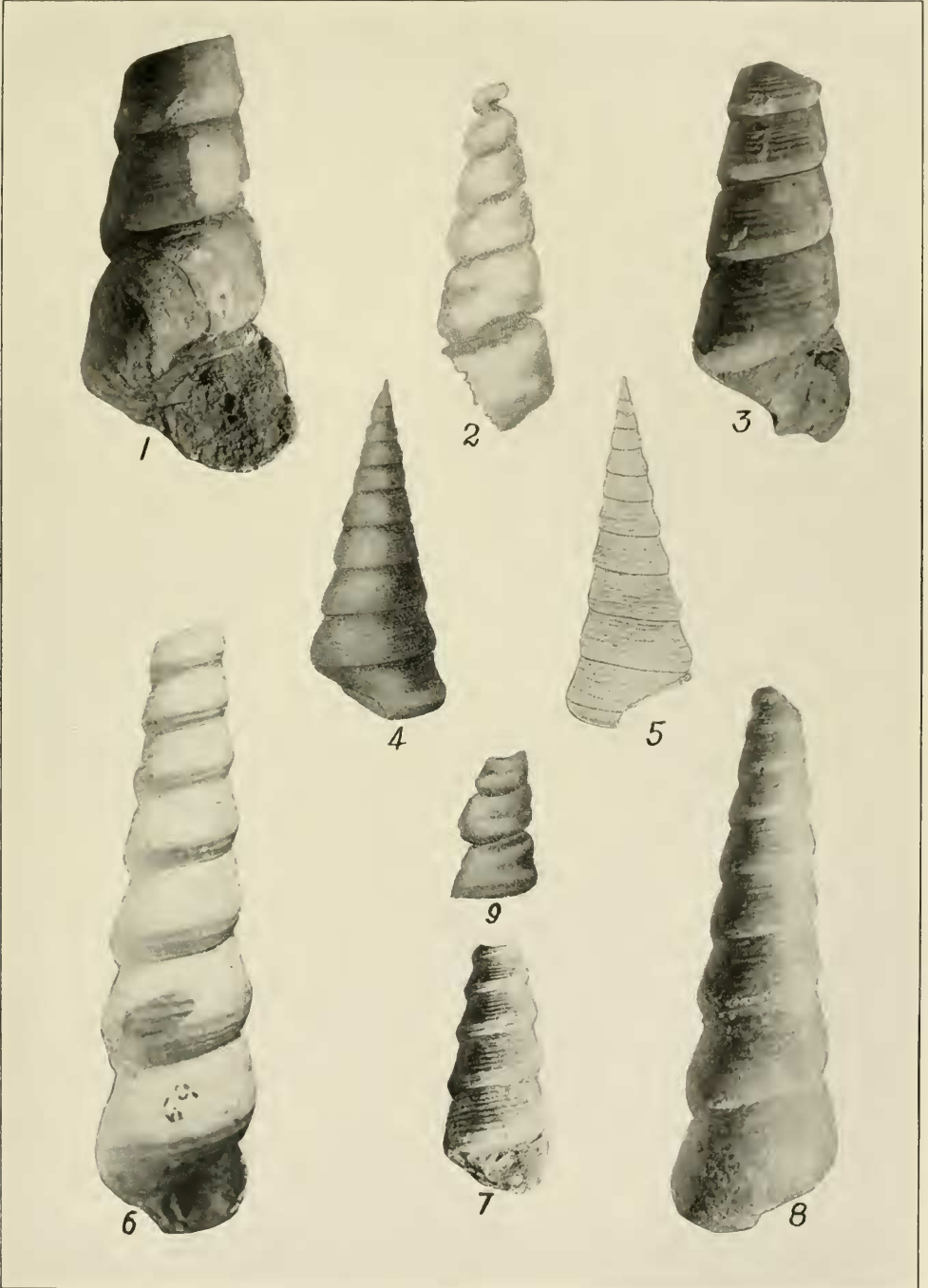


PLATE 11

FIGURE	PAGE
1. <i>Turritella bösei</i> Hertlein and Jordan.	117
Natural size. Plesiotype No. 45, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 428. Collected two miles southeast of El Modena, Orange County, California. Temblor formation, middle Miocene.	
2. <i>Turritella bösei</i> Hertlein and Jordan.	117
Natural size. Plesiotype No. 46, S.D.S.N.H. type collection, from the same locality as figure 1.	
3. <i>Turritella bösei</i> Hertlein and Jordan.	117
Natural size. Plesiotype No. 427, L.S.J.U. type collection, from S.D.S.N.H. and L.S.J.U. locality 442. Collected at Barker's Ranch, Kern County, California. Temblor formation, middle Miocene. This individual shows the aperture and variation found in the species.	
4. <i>Turritella temblorensis</i> Wiedey, sp. nov.	122
Natural size. Syntype No. 15, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 425. Collected from a tributary of Dry Canyon, two miles south of Calabasas, Los Angeles County, California. Temblor formation, middle Miocene.	
5. <i>Turritella bösei</i> Hertlein and Jordan.	117
Natural size. Plesiotype No. 428, L.S.J.U. type collection, from the same locality as figures 1 and 2.	
6. <i>Turritella bösei</i> Hertlein and Jordan.	117
× $\frac{2}{3}$. Rephotograph of the syntype, from Lower California, now in the L.S.J.U. type collection, for the purposes of comparing with other figured individuals. Gerontic whorls of the syntype show similarity to whorls of <i>T. ocoyana</i> Conrad.	
7. <i>Turritella temblorensis</i> Wiedey, sp. nov.	122
Natural size reproduction of a form figured by Arnold as <i>T. variata</i> Conrad.	
8. <i>Turritella temblorensis</i> Wiedey, sp. nov.	122
Natural size reproduction of another form figured with figure 7 as <i>T. ocoyana</i> Conrad.	
9. <i>Turritella temblorensis</i> Wiedey, sp. nov.	122
Natural size. Syntype No. 419, L.S.J.U. type collection, from the same locality as figure 4.	

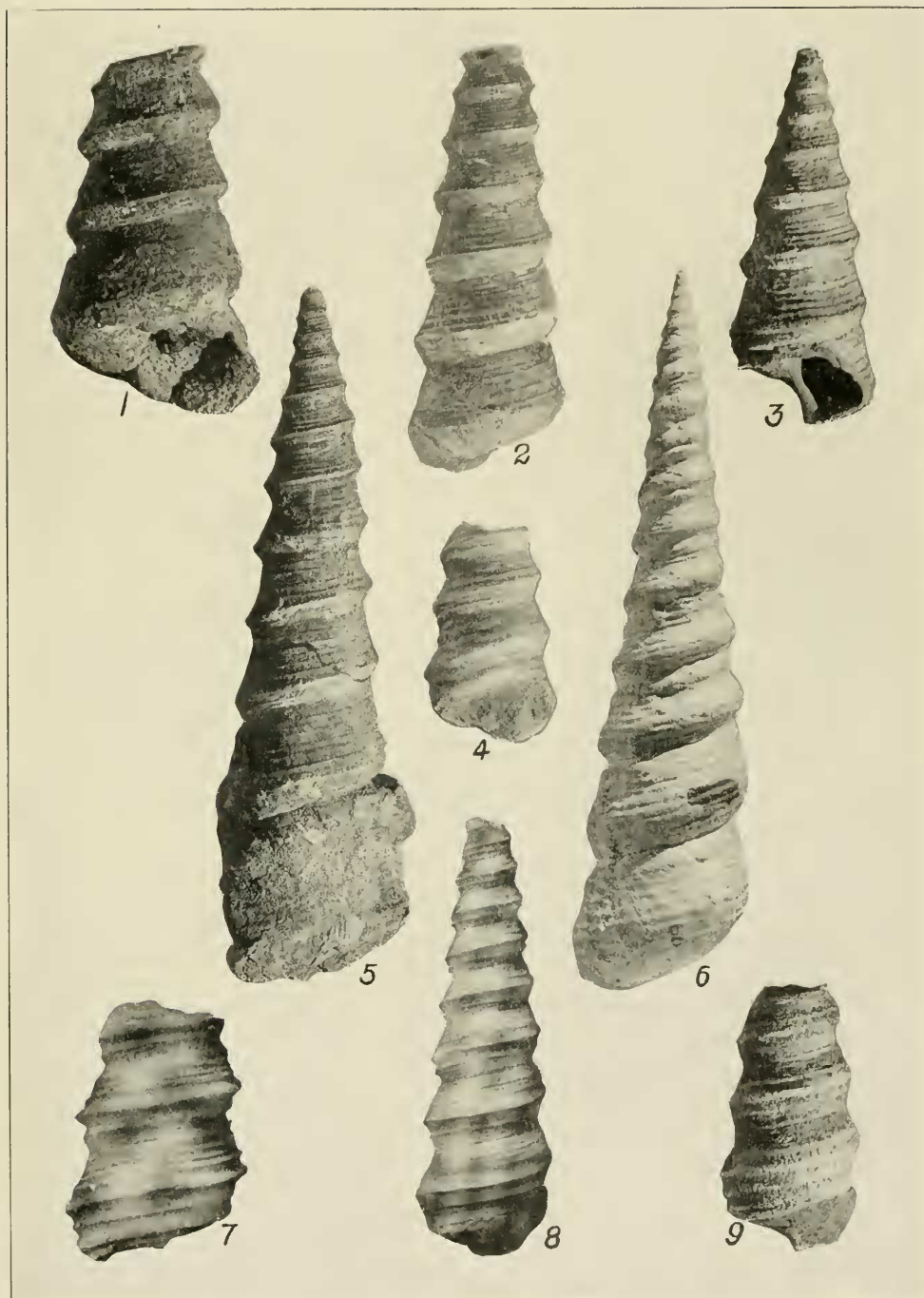


PLATE 12

FIGURE	PAGE
1. <i>Turritella inczana</i> Conrad, var. <i>pertumida</i> Wiedey, var. nov.	119
Natural size. Holotype No. 14, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 441. Collected from Corral de Piedra, five miles east of San Luis Obispo, San Luis Obispo County, California. Vaqueros formation, lower Miocene.	
2. <i>Turritella inczana</i> Conrad.....	119
Natural size. Plesiotype No. 48, S.D.S.N.H. type collection, from the same locality as figure 1. Typical of the species.	
3. <i>Turritella inczana</i> Conrad.....	119
Natural size. Plesiotype No. 429, L.S.J.U. type collection, from the same locality as figures 1 and 2. Indicates the direction and amount of variation of the species.	
4. <i>Turritella inczana</i> Conrad, var. <i>sespensis</i> Arnold.....	121
Natural size. Plesiotype No. 49, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 445. Collected from Squaw Flat, Sespe Oil district, Ventura County, California. Vaqueros formation, lower Miocene. The individual figured is a far better specimen than the type (which seemingly was figured upside down), collected from near the type locality.	
5. <i>Turritella variata</i> Conrad.....	120
Natural size reproduction of the type figure of the species given by Conrad. It shows the tendency toward tabulation of the top of the whorl.	
6. <i>Turritella inczana</i> Conrad, var. <i>pertumida</i> Wiedey, var. nov..	119
Natural size. Paratype No. 418, L.S.J.U. type collection, from the same locality as figure 1.	
7. <i>Turritella inczana</i> Conrad.....	119
Natural size. Plesiotype No. 430, L.S.J.U. type collection, from the same locality as figure 1. Shows the tendency toward nearly flat sided whorls.	
8. <i>Turritella variata</i> Conrad.....	120
Natural size. Plesiotype No. 50, S.D.S.N.H. type collection, from the same locality as figure 1. Shows the heavily sculptured, strongly tabulate topped whorls, considered typical of the species.	

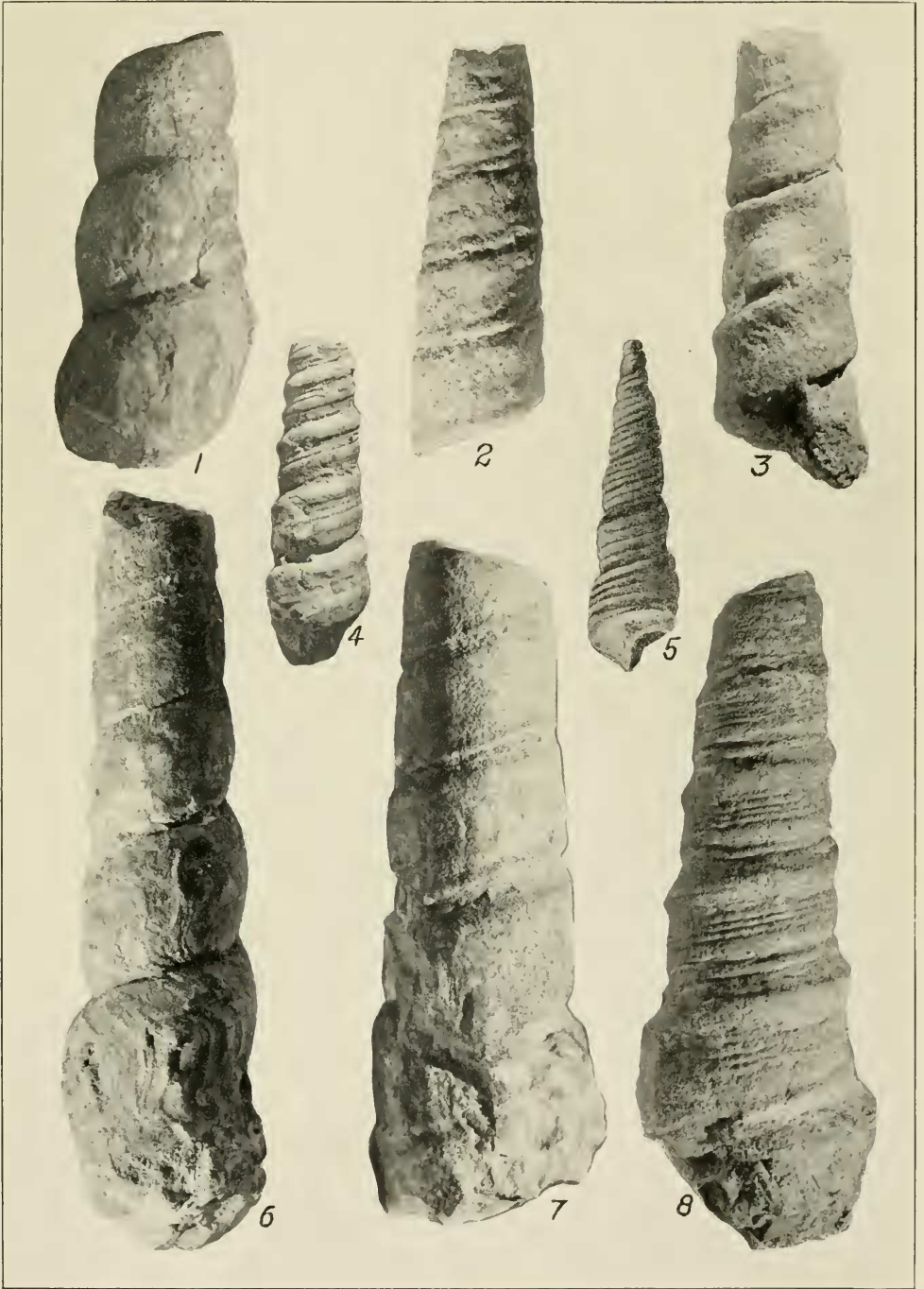


PLATE 13

FIGURE	PAGE
1. <i>Arca sespensis</i> Wiedey, sp. nov.	125
Natural size. Holotype No. 17, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 407. Collected from the mouth of the Little Sespe Creek, north of Fillmore, Ventura County, California. Vaqueros formation, lower Miocene.	
2. <i>Arca hamelini</i> Wiedey, sp. nov.	126
Natural size. Holotype No. 18, S.D.S.N.H. type collection, from the same locality as figure 1.	
3. <i>Arca rivulata</i> Wiedey, sp. nov.	128
Natural size. Holotype No. 20, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 432. Collected in eastern San Luis Obispo County, California. Temblor formation, middle Miocene.	
4. <i>Arca lakei</i> Wiedey, sp. nov.	127
Natural size. Holotype No. 19, S.D.S.N.H. type collection, from the same locality as figure 3.	
5. <i>Arca lakei</i> Wiedey, sp. nov.	127
Natural size. Full view of the form illustrated in figure 4.	
6. <i>Arca perdisparis</i> Wiedey, sp. nov.	131
Natural size. Holotype No. 23, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 443, from the same locality as figure 1, plate 14.	
7. <i>Arca obispoana</i> Conrad.	131
Natural size. Plesiotype No. 432, L.S.J.U. type collection, from S.D.S.N.H. and L.S.J.U. locality 445. Collected from Wagon Wheel Mountain, Kern County, California. Temblor formation, middle Miocene. This specimen is figured to illustrate the characteristics of Conrad's species, which has been quite disregarded.	
8. <i>Arca galci</i> Wiedey, sp. nov.	129
Natural size. Holotype No. 21, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 427. Collected from Benedict Canyon, Santa Monica Mountains, Los Angeles County, California. Temblor formation, middle Miocene.	
9. <i>Arca procumbens</i> Wiedey, sp. nov.	132
Natural size. Top view of the combined valves of this species, from S.D.S.N.H. and L.S.J.U. locality 444. Collected five miles north of Yaquina Head, Lincoln County, Oregon. Middle (?) Miocene.	
10. <i>Arca procumbens</i> Wiedey, sp. nov.	132
Natural size. Syntype No. 24, left valve, S.D.S.N.H. type collection, from the same locality as figure 9.	
11. <i>Arca procumbens</i> Wiedey, sp. nov.	132
Natural size. Syntype No. 420, L.S.J.U. type collection, from the same locality as figures 9, 10.	

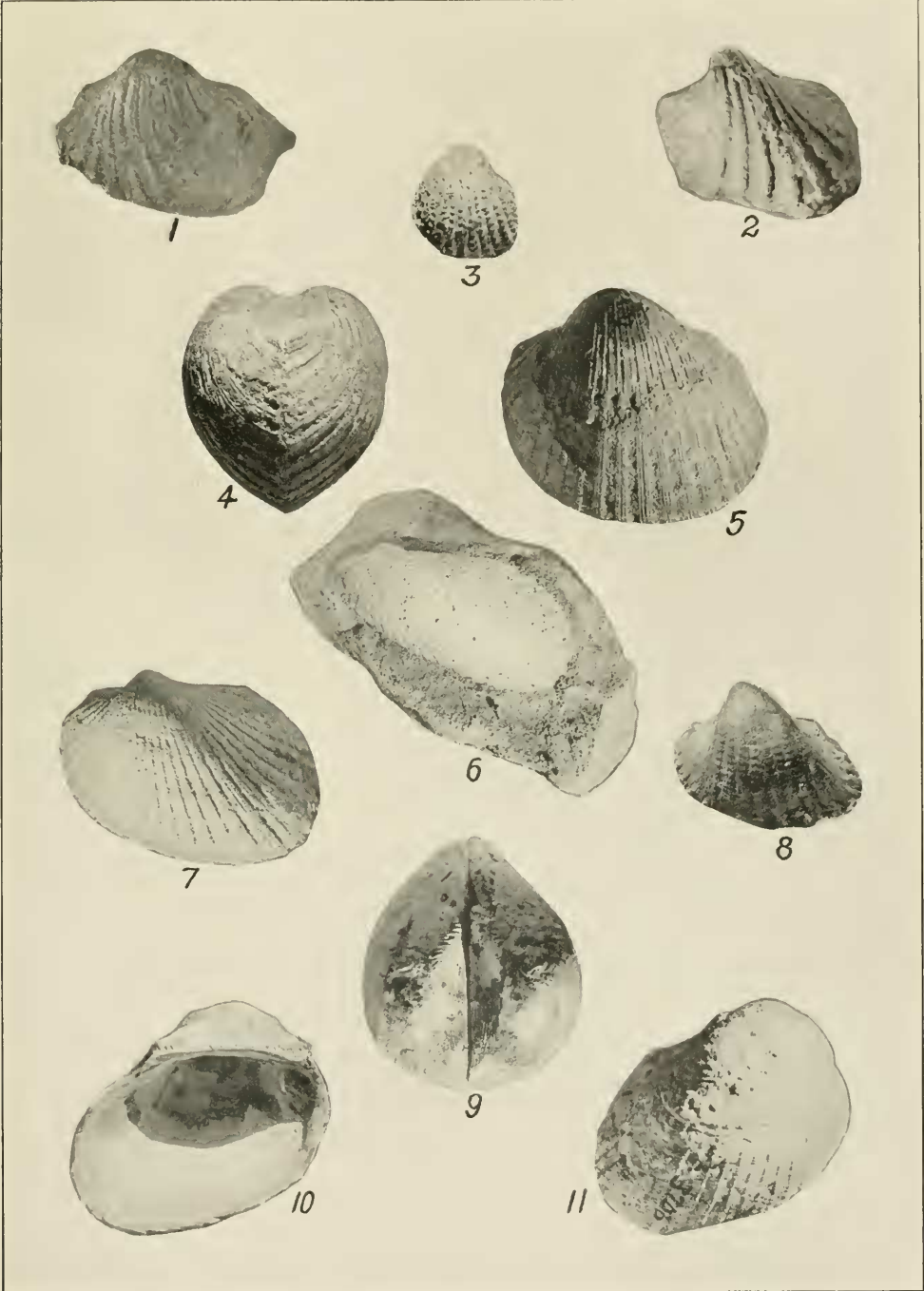


PLATE 14

FIGURE	PAGE
1. <i>Arca perdisparis</i> Wiedey, sp. nov.	131
Natural size. Plesiotype No. 433, L.S.J.U. type collection, from S.D.S.N.H. and L.S.J.U. locality 443. Collected three-quarters of a mile southwest of Zayante Station, Monterey County, California. These casts are apparently variants of this variable species. Monterey formation, middle Miocene.	
2. <i>Arca impavida</i> Wiedey, sp. nov.	130
Natural size. Holotype No. 436, L.S.J.U. type collection, from S.D.S.N.H. and L.S.J.U. locality 442. Collected at the Barker Ranch locality of Kern County, California. Temblor formation, middle Miocene.	
3. <i>Arca impavida</i> Wiedey, sp. nov.	130
Natural size. Full view of the individual, figure 1.	
4. <i>Pteria jordani</i> Wiedey, sp. nov.	134
$\times \frac{3}{4}$. Holotype No. 25, S.D.S.N.H. type collection, from S.D.S.N.H. and L.S.J.U. locality 425. Collected from a small canyon which trends westward from the head of Dry Canyon, two miles south of Calabasas, Los Angeles County, California. Temblor formation, middle Miocene.	

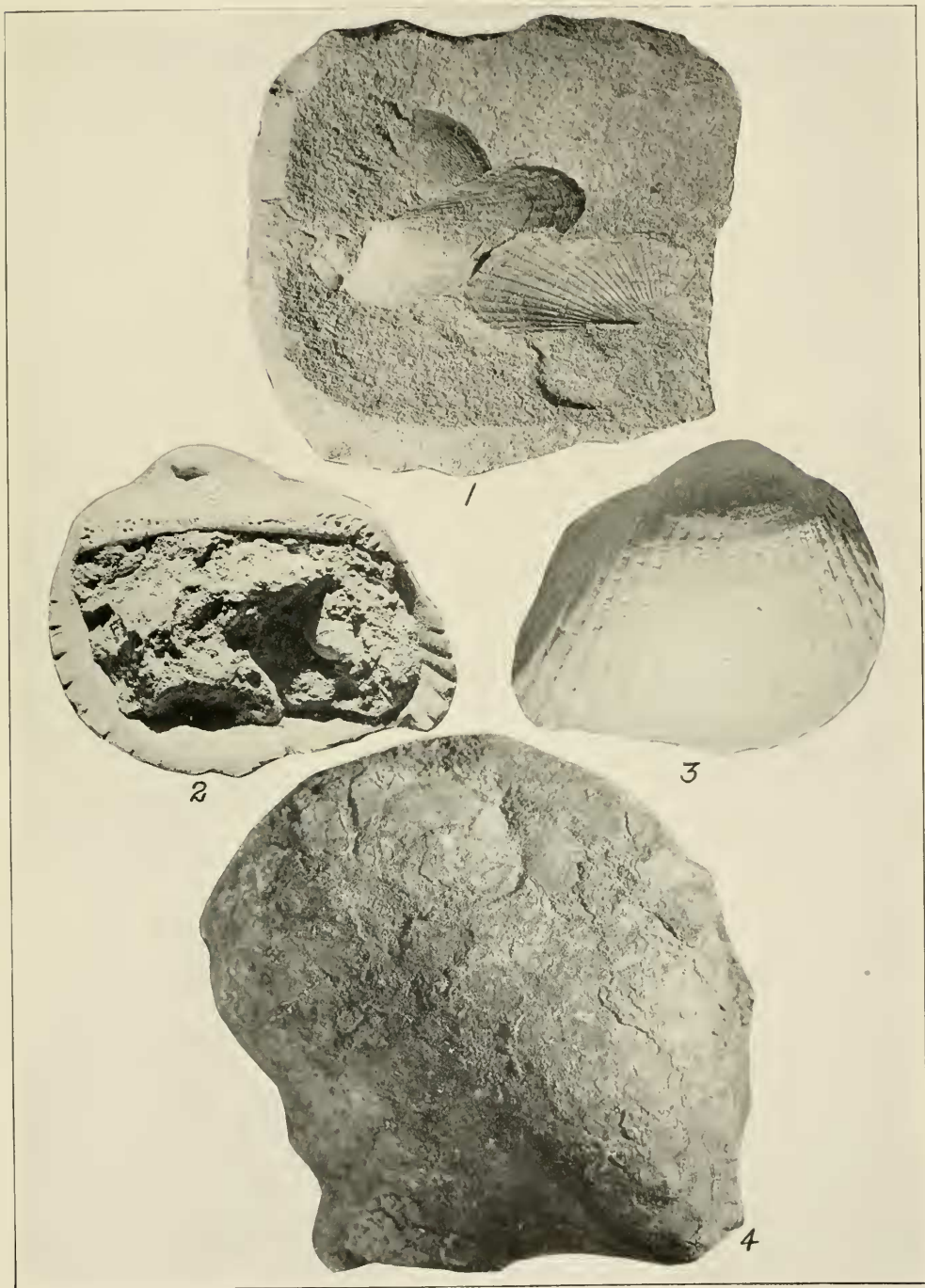


PLATE 15

FIGURE	PAGE
1. <i>Ostrea howelli</i> Wiedey, sp. nov.	135
<p style="margin-left: 40px;">Natural size. Holotype No. 26, S.D.S.N.H. type collection, from S.D.S.N.H and L.S.J.U. locality 446. Collected from a locality in the Mt. Pinos quadrangle, five and one-half miles northeast of Wheeler's Hot Springs, Ventura County, California. Middle (?) or upper (?) Miocene.</p>	
2. <i>Ostrea howelli</i> Wiedey, sp. nov.	135
<p style="margin-left: 40px;">Natural size. Interior aspect of the individual, figure 1.</p>	
3. <i>Pteria jordani</i> Wiedey, sp. nov.	134
<p style="margin-left: 40px;">× $\frac{3}{4}$. Paratype No. 421, L.S.J.U. type collection, from S.D.S.N.H. and L.S.J.U. locality 425. Collected from a small canyon which trends westward from the head of Dry Canyon, two miles south of Calabasas, Los Angeles County, California. Temblor formation, middle Miocene.</p>	